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LIGHTING RATES IN SMALL CENTRAL STATIONS.

The question of a reasonable rate for electric lighting service in very small central stations is one of considerable importance. In each case the total amount of money involved may not be large, but the principles which determine a fair charge are significant, and the large number of small plants in different parts of the country justifies reference to the matter at this time. The problem of a reasonable rate is somewhat simpler in the small plant, usually, than in the larger community, although the same general methods of investigation must be applied to each case before it can be settled whether the charges are proper. In a single sentence, the reasonableness of the rate is dependent upon a fair return upon the investment after all operating expenses and fixed charges have been deducted from the total revenue. Where the smaller municipalities frequently err is in not appreciating the extent to which these fixed charges should be applied and the vast differences between the possibilities of cheap operation and future development that ordinarily exist between a little plant in a small town or village and one in a growing and prosperous city. And it is well to be noted also, that not a few small plants prejudice their cases before the local authorities by reason of the very inadequate methods of keeping track of their expenses and fixed charges. Improvement in keeping records of income and outgo, with allowances for interest, depreciation, taxes, insurance, and extraordinary expenses, wil do much to prevent appeals to state boards, after the company comes before the local authorities to plead its case.

In a case which came before the Public Service Commission of the Second District, New York, last year, a charge of twenty cents per kilowatt-hour on a meter installation and an arc lamp charge of twenty-seven cents per night for five hours' run were sustained against the appeal of the local authorities of the village of Adams. Without reviewing the case in full at this time, it may be stated that the plant was of the old type, in fair operating condition; it depended on steam for its current generation, with the exception of a small water-power auxiliary available for short periods; it represented an investment of about $17,000 on the Commission's appraisal; and the rate of twenty cents included free lamp renewals and covered considerable labor which was furnished free of charge for repairs or new installations. There were twenty-four arc lamps installed for street lighting and the plant furnished incandescent light to houses and stores from dark until midnight,

also running in the early morning for the accommodation of customers, according to the time of year. The value of the power plant was $10,650, and of the distribution system, $6,950. The supervision of the plant cost about $1,000 per year; the gross receipts were about $6,000, and the operating expenses, excluding supervision, interest and depreciation, were approximately $3,900.

The Commission found that, allowing six per cent interest on the estimated value of the plant and distribution system, and figuring all charges, there was a net deficit for the year of almost $1,000. The comments made in the decision at this point are applicable to hundreds of small stations: "It appears to be clear that the above financial showing does not give any margin which will justify a reduction in rates, unless it can be satisfactorily proved that such a reduction would result in a large increase in business, and no satisfactory evidence was furnished that would justify this Commission in concluding that a reduction would lead to enough business to justify it. . . . The connected load of the plant represents nearly the normal demand of a community of this size (eighty-seven customers' meters) and kind, and it is not believed that there is opportunity to largely increase the gross receipts, either by the betterment or extension of the service, or by a reduction in the rates. Conditions are unfavorable for a steam power operating electric plant, in that the use of a plant is limited, the output is small, and the interest, depreciation and labor form a relatively high proportion of the cost per kilowatt-hour output. . . . The public arc service does not lend itself to a low rate per lamp per year on account of the small amount of service, which is approximately 1,200 hours per year per lamp, as compared with the all night and every night service prevailing in many larger towns and involving about 4,000 hours of lighting per lamp per year.

"The meter rate of twenty cents per kilowatt-hour for incandescent lights for houses appears high as compared with larger places, and inquiry by the village authorities is therefore justified. It, however, appears clear that no profit is being made by the company, and it should be remembered that the small demand for electric light in a village of this size involves a high cost of plant and of distribution system per unit of output. In fact, it is very questionable whether the amount of electric lighting which can be secured in a village of this size justifies the installation of an electric-light plant at all unless cheap waterpower is available."

These principles should be emphasized wherever appeals are made in thinly populated communities for rate reductions, and the whole situation carefully figured over with all the contingencies in mind. Inch by inch, the American people are learning that there are fundamental differences between the supply of electrical energy and the sale of tangible merchandise which render it impossible to sell the product of a central station as sugar and flour are retailed over the counter. Public sentiment unquestionably can be educated to appreciate these points if sufficient pains are taken to explain the technical features of production and the numerous and legitimate expenses which surround them.

INCOME PER INHABITANT.

Population is the basis of income in general electrical supply.

For this reason the population of a city is one of the first considerations when the probable earnings of an electric plant there located are to be determined. True it is that the bare figures for population without data as to its character and occupation are an uncertain basis for the computation of earnings. On the other hand, where the population and the nature and extent of the industries in a city are known, a reliable estimate of electric earnings can usually be made.

For the purpose of such an estimate, however, it is very necessary to have a record of what has been done elsewhere under similar conditions, and it is also desirable to know the time in which the given results were reached.

Recently a municipal electric plant was proposed for a certain city, and an estimate was put before the Council that purported to show a probable gross earning of nearly four dollars per inhabitant annually from commercial business alone, during the second year of operation, though a private corporation owned an electric system that it was not proposed to purchase, in the same city.

Subsequently, when Alton D. Adams, of Boston, Mass., was asked for an opinion as to the proposed municipal plant, it was thought desirable to collect some data as to the earnings of electric plants in cities of somewhat similar size to the one in question, and a part of the data thus obtained is presented below.

The figures for population are from a state census, and the year for which incomes are given covers one-half of the census year. Each of the electric plants considered had been established not less than fifteen years, had no competition, and its prosperous condition was the result of a gradual growth.

In each case the electric plant is owned by a private corporation, and where energy was sold to electric railways or to other companies engaged in electrical supply, the income thus obtained is not included in that given here.

One plant was located in a city of 33,000 population, and the gross electric income per inhabitant was $3.21 for both public and private service, of which $1.03 was for street lighting alone. This city is devoted to manufactures to an unusual degree, but many of the mills require large units of power that the electric plant has not been able to supply. A large percentage of the population is employed in the mills and is not able to pay electric rates for house lighting, and the opportunity for store, theatre and hotel lighting is less than usual for a place of this size. So it was in this case that all commercial service yielded $2.18 per inhabitant during the year in question, and of this amount $1.27 was from lighting and $0.91 from power supply.

In another city the population was 37,000, and the total

electric income amounted to $3.70 per inhabitant for the year, of which $1.07 was derived from street lighting and $2.63 from all other light and power service. The population here included a good proportion of well-to-do people, varied manufacturing interests, and only limited theatre and retail facilities, with the result that the power load yielded $0.39 and the commercial lighting $2.24 per inhabitant, during the year.

A smaller city than either of the above contained 20,000 people, and the entire earnings of the electric plant were $3.01 per unit of the population, while only $0.60 of this amount was from street lighting and $2.41 was earned by commercial service. This was a college town with a moderate amount of manufacturing and of retail business, so that of the $2.41 per inhabitant $0.30 was the income from motor service and $2.11 from private lamps.

Fifteen thousand people in another city paid $4.31 each on an average for electric light and power during the year, and of this sum $1.70 went for street lamps and $2.61 for commercial service. This city has many residents of large means, is something of a summer resort, and is too near a far larger city to do much in retail trade. Its manufacturing interests are quite moderate, and this may account for the fact that motor service yielded only $0.23 while $2.38 per inhabitant was obtained from commercial lighting.

In the last place here considered the population was a little under 13,000, the smallest of any of the five cities named, but the electric earnings per inhabitant were the largest, being $5.10 on an average. Street lighting was an item here of $0.87, leaving $4.23 as the average commercial income from each resident of the city during the year. This city offered an unusually good field for the development of a power load, owing to its large number of manufacturing plants using ten to 100 horsepower each, and this field was well developed, so that the incomes from commercial light and power, respectively, were equal during the year in question.

Demands for lighting by the retail, theatre and hotel interests were only moderate, but the economic condition of the population gave a good opening for electric lamps in residences. Of the total commercial income amounting to $4.23 per inhabitant, the yield of electric power service was $2.12 and of lighting $2.11. This figure of $2.12 income from power service is more than double that in either of the other cities named, and it is safe to say that it has been duplicated in very few cities anywhere in the world.

Reverting to the proposed municipal electric plant in a city of similar size to one of the above, and making any reasonable assumption as to conditions there, it is easy to form an opinion from the above data as to whether an earning between three and four dollars per inhabitant could fairly be expected during the second year of its operation, in the face of competition by the existing system.

Before cities build municipal electric plants they should have before them reasonable estimates of earnings, and not rely on fairy tales.

ANOTHER ELECTRICAL TRIUMPH IN THE MUSICAL WORLD.

A new musical instrument operated by electricity has lately made its first public appearance in Boston at a concert, in which the Boston Symphony Orchestra also took part. The new device is called the Choralcelo, and its essential peculiarity consists of the vibration of piano wires by electromagnets, resulting in the production of tones of surpassing purity, if the judgment of those who have heard the instrument is to be credited. The working parts of the instrument are housed in a case resembling that of a rather large upright piano, and the instrument may be played as a piano by the ordinary percussion hammers and keys, either separately or at the same time, with the electromagnetic action. The tones of the instrument are said to resemble those of both stringed and wood equipment for orchestral service, and the organ characteristics are reported to be perhaps the most beautiful of all. Less than one horsepower of electrical energy is required to operate the Choralcelo in full harmony.

The future of such an instrument must be left to the musical world, but from the scientific point of view it is significant that electricity should be the medium for the production of effects which never before have been heard by the human ear. The Choralcelo principle being established, electricity has added one more benefaction to human enjoyment. Mankind will find it hard to pay the debt it now owes to this wonderful medium, which astonishes us year after year with its achievements in the betterment of conditions on this troubled planet. Life without electricity is now almost unthinkable in civilized communities. Each new step forward, whether in the transmission of the energy of mighty cataracts over vast and varied reaches of land and water to drive the looms of industry hundreds of miles from the power house, or in the improvement of human intercommunication or enjoyment, marks the approach of the goal at which civilization will depend upon electricity almost to the exclusion of all other natural agencies. The possibilities of the immaterial bridge of ether between the cause and its effect desired, are yet far from exhausted. We often hear it said that the electrical field is overcrowded with workers, but the introduction of new apparatus for the benefit of humanity constantly expands it. We may discover few fundamental principles in the early part of this century, but each new application which does something better than before, or which creates an entirely new source of profit or enjoyment, widens the sphere of the whole electrical world. The indirect benefits of each new development are difficult to measure, but they are real. The introduction of a new device and the creation of a demand for it stimulate activity all along the line. Existing facilities are used to a larger extent, labor is freshly employed and materials purchased and transported. Demands for power, light and communication arise, to the benefit of the central station and the manufacturing plant. It is desirable to realize these incidental conditions no less than the fundamental gain which the world obtains when a new development is perfected.

CALIBRATION OF A BALLISTIC GALVANOMETER FOR CLOSED CIRCUIT WORK.

BY F. M. HARTMANN AND ALBERT BALL.

One of the difficulties met with in making magnetic tests by means of the test coil and ballistic galvanometer arises from the damping of the needle due to the current induced by the swing.

The variation of the earth's magnetic field at most points, where such tests are likely to be made, makes necessary the use of a galvanometer of the D'Arsonval type and of the condenser method of calibration. In order to make use of such a calibration when the galvanometer is used on a closed circuit the following method has been found most convenient:

A definite quantity (q) is discharged from a condenser through the galvanometer and both the first and second swings of the needle are noted. The same quantity is again discharged, note being made that the first swing agrees with that produced by the first discharge, and just as the needle passes the zero point the galvanometer circuit is closed through the same resistance as the test-coil circuit in which the galvanometer is to be used, and the second swing again noted. This second swing is made under precisely the same conditions of damping as when the galvanometer is used in the magnetic test.

If we call the open-circuit swing d_2 and the corresponding damped swing d'_2 we may by varying q determine values of d_2 corresponding to several values of d'_2 throughout the range of the instrument. If a curve be plotted with these values as co-ordinates we may use the galvanometer on the closed circuit, observe the damped deflections and from the curve determine what the deflections would have been had there been no damping. From these corrected deflections and the calibration curve we may determine the quantity of electricity.

The reliability of such a calibration depends of course upon the ability of the observer to close the key at the instant the needle reaches the zero point. That the probable error need not be large may be seen from the following results obtained by Geo. F. Bateman in the Cooper Union Laboratories, New York, N. Y., under the direction of the authors:

DEFLECTIONS READ BY LAMP AND SCALE —SCALE DIVISIONS ABOUT ONE MILLIMETRE.

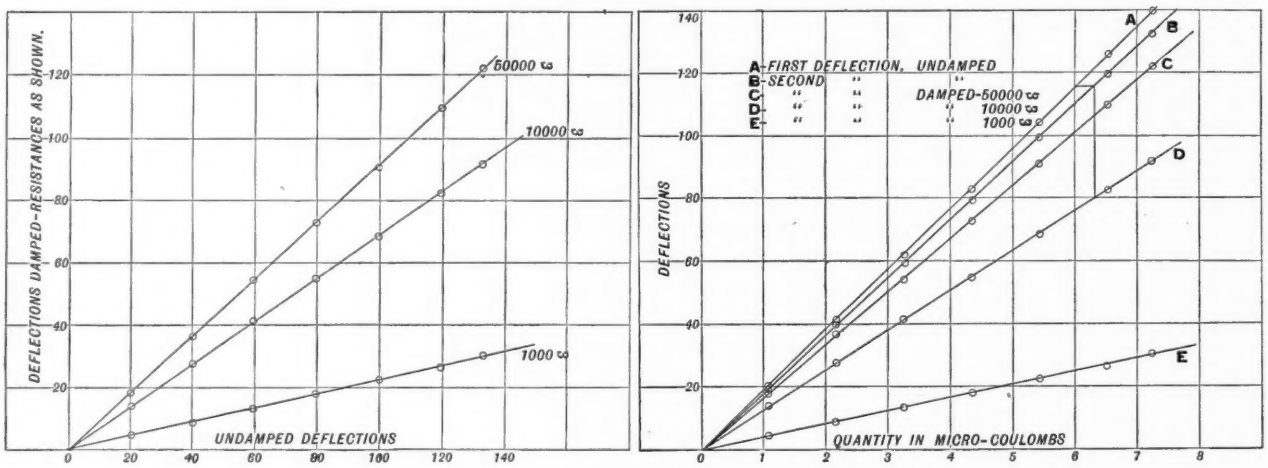
		Second Swing, Circuit Closed Through		
Circuit Open, First Swing.	Second Swing.	50,000 Ohms.	10,000 Ohms.	1,000 Ohms.
140.4	133.0	121.8	92.2	30.5
140.4	133.0	122.5	90.8	29.0
140.4	133.0	121.5	91.5	31.0
140.4	133.0	122.0	92.0	31.5
140.4	133.0	122.0	92.5	31.8
140.4	133.0	122.0	91.0	30.0
140.4	133.0	122.0	92.0	31.2
140.4	133.0	121.5	92.0	29.0
140.4	133.0	122.0	91.0	31.0
140.4	133.0	122.5	90.7	29.2
Means 140.4	133.0	122.0	91.6	30.4

It will be noted from the above set of ten readings that even when the damping was as much as seventy-five per cent of the open-circuit swing, the maximum variation of the individual observations from the mean is only about four per cent, while with smaller damping the variation is much less.

In the following table the deflections given are means of five observations:

Micro-Coulombs.	Open Circuit, First Swing.	Second Swing.	Second Swing, Circuit Closed Through 50,000 Ohms.	10,000 Ohms.	1,000 Ohms.
1.085	20.4	20.1	18.3	14.0	4.7
2.170	41.2	40.0	36.9	28.0	8.8
3.260	62.2	59.5	54.4	41.7	13.5
4.35	83.0	79.5	72.9	55.0	18.2
5.43	104.5	99.5	91.3	68.4	22.7
6.51	126.0	119.5	109.3	82.5	26.9
7.23	140.4	133.0	122.0	91.6	30.4

The curves plotted from these data indicate the consistency of the observations. The first set of curves are plotted as already stated. The second set of curves plotted between q and d_1, d_2 and d'_2 is even more useful, as the quantity of electricity corresponding to any deflection may be read off directly; *e. g.*, if the damped deflection (first swing) in a magnetic test in which the resistance of the galvanometer circuit is 10,000 ohms is eighty scale divisions, the corresponding quantity of electricity is six micro-coulombs.



New System of Electric Traction in Switzerland.

Consul Francis B. Keene, of Geneva, reports that a new system of electric traction, invented by a Vienna firm of engineers, is soon to be the subject of extensive experiment at Sion, in the Swiss Canton of Valais, known as the Rhone Valley. It is described as having only an overhead contact cable, without ground rails, and the claim is made that it saves unnecessary expense, and that it will probably be adopted for tramways with steep gradients and for mountain railways. Further details of the system are withheld until after the tests.

Conservation of Waterpowers—Action by the National Government.

An order has been issued from the Department of the Interior, Washington, D. C., that the Director of the Geological Survey shall ascertain what waterpowers are in the public domain, and not within the bounds of the national forests, for the purpose of taking such steps as may be necessary to procure legislation by Congress to control and regulate the disposition of these sites. L.

REVIEW OF THE WATERPOWERS OF SOUTH CAROLINA—DEVELOPED AND UNDEVELOPED.

BY S. MAYS BALL.

G. E. Shand, C. E., estimates that there is approximately 300,000 horsepower available on the streams of the state of South Carolina for practical development, of which about 125,000 has been developed, though not all utilized, leaving 175,000 horsepower in the state still available. The waterpower companies in the state will sell now, at a profit, power to manufacturing companies at from $17.50 to $25 per electrical horsepower, the price depending upon the quantity purchased and on the distance the current is transmitted. The cost of power generated for 3,000 hours per year by steam in South Carolina, plants being in good condition, using coal at $4 per ton and evaporating in the boilers eight pounds of water per pound of coal, is about as follows per horsepower:

With high-speed, simple engines	$23.80
With Corliss simple, non-condensing	19.31
With Corliss simple, condensing	15.59
With Corliss compound, condensing	11.11

These figures are for fuel only, and to them must be added the cost of maintenance and depreciation of plant, attendance and supplies, from $6 to $10 per horsepower.

The first waterpower in South Carolina developed for the purpose of selling power was the Columbia Canal. The company which owns this is selling power for electrical transmission to the manufacturing plants of that city for lighting and street-railway purposes. The first time waterpower electrically transmitted was used for driving a cotton mill in this country was from this plant. The owning company has more demand for power than it can fill.

The next power developed for sale in South Carolina was by the Anderson Light and Power Company, at Portman Shoals on the Seneca River. This power is used at Anderson for lights by cotton mills and other purposes. There is a greater demand for power at Anderson than can be met.

The Southern Power Company, with headquarters in Charlotte, owns six powers on the Wateree or Catawba River and one on the Broad River. It developed one on the Catawba River above Rock Hill a few years back, from which it sells 10,000 horsepower, as do the other companies before mentioned; the demand for power not having been met, it has just finished a larger development of 32,000 horsepower at Fishing Creek on the Catawba River and has another under way at Ninety-Nine Islands on the Broad River.

The Union Manufacturing and Power Company has developed 6,500 horsepower at Neals Shoals on the Broad River, all of which is sold to cotton mills at Union.

Hugh McRae & Co., of Wilmington, have recently purchased Hattons Ford on the Tugaloo River, where they will utilize about sixty feet fall to generate 5,000 horsepower for sale in Anderson, seventeen miles away.

The Saluda River Power Company has developed about 3,000 horsepower at a point on the Saluda above Greenville that is transmitted and sold in Greenville.

The Savannah River Power Company has about completed a development at Greggs Shoals on the Savannah, from which it will furnish power to Anderson, Abbeville and Greenwood.

The Twin City Power Company proposes to develop immediately quite a large power on the Savannah, about twenty miles from Augusta, Ga.

The streams of South Carolina have not been very definitely surveyed. When this work is completed it is believed that from such a survey there will be found hundreds of undeveloped powers available in the state that could be made economical producers of power where manufacturing plants now demand it.

The abundance of rock and sand for building purposes and the good foundations available for hydraulic construction make a low cost of developing powers which have been from $60 to $150 per horsepower, including electrical transmission. The local conditions, size of development and length of transmission lines affect cost to a large extent. The shoals are for the most part formed by gneiss ledges, which furnish good building stone.

The state of South Carolina is divided geologically into six sections, viz.: Sea coast, lower pine belt, Red Hills country, Sand Hills, Piedmont section and mountains. The first three sections are flat land which attains an elevation of about 130 feet above sea level at the foot of the Red and Sand Hills and Piedmont region. The Red Hills have elevations up to 500 feet; the Sand Hills elevations of 700 feet; the Piedmont of 1,200 feet, the mountains of over 3,000 feet. The large waterpowers, developed and undeveloped, are in the Piedmont section, which extends north of Columbia and to the foot of the mountains, while numerous smaller powers are to be found in the streams of the Sand Hills and mountains.

There are three great river systems that drain the state—the Pedee, Santee and Savannah.

Pedee River.—This river has its source in the northwest corner of North Carolina, with one feeder extending up into Virginia. After traversing 150 miles of North Carolina and draining 9,700 square miles of its territory, it enters South Carolina and flows on to the ocean at Georgetown. This river is navigable from the ocean up to Cheraw, where the first river falls come at the foot of the Sand Hills. Although this is the largest river that flows in the state, it has no valuable waterpowers of note in South Carolina, as it reaches its low level shortly after crossing the state boundary line.

Santee River.—This river system comprises the Congaree and Wateree rivers with their tributaries and furnishes the larger part of the waterpowers of the state. The Congaree River is formed by the junction of the Broad and Saluda rivers at Columbia. It has no waterpowers except at the point of formation, where the Columbia Canal utilizes a portion of its waters and fall. The Broad River rises in the mountains of North Carolina and carrying the drainage from 1,400 square miles it enters the state of South Carolina at an elevation of 120 feet above sea level, giving a total fall of 630 feet and having a total drainage area of 4,950 square miles. The Saluda River rises in North Carolina and drains 300 square miles of that state. Some of its waters spring at an elevation of over 2,000 feet, and at its formation by the junction of the South Forks and Middle Saluda it has an elevation of 900 feet, giving a total fall from this point to its juncture with the Broad of 766 feet; it has a total drainage of 2,350 square miles. The Wateree River (known as the Catawba) is navigable up to the shoals above Camden. This river rises in the middle portion of North Carolina and, carrying the drainage from 3,085 square miles of that state, it enters South Carolina at an elevation of about 515 feet, giving a total fall within the state of 395 feet down to Camden, where it has a drainage area of 4,376 square miles.

Savannah River.—For its full length this river is the boundary between South Carolina and Georgia, and its tribu-

taries, the Tugaloo and Chatuga rivers, form the state line up to the extreme northwestern corner of the state of South Carolina. The headwaters of the Tugaloo and Seneca rivers have their source over 1,000 feet above sea level, and these rivers form the Savannah at an elevation of 567 feet and bring to it the drainage from 1,970 square miles of country. The Savannah flows down to Augusta, Ga., through 337 feet of fall, and at that point has a drainage area of 6,830 square miles. This river and its tributaries have many valuable developed and undeveloped waterpowers.

The rainfall in all the basins of South Carolina is approximately fifty-one inches, but in the mountainous section, which includes the greater part of the North Carolina drainage area of the Santee and Savannah systems, the rainfall is much greater, and this mountainous section is of great value in maintaining the even flow of the rivers, both on account of large rainfall and of its large wooded area. The Sand Hills are also excellent feeders, as their porous soils absorb a large proportion of the rainfall, giving a greater flow per square mile of drainage area than any other section.

Discussing the rivers in South Carolina separately, we find the following known powers which are of interest:

ON THE BROAD RIVER.

Along the Broad River are located:

(1) The Columbia Canal, which, by means of an eight-foot dam and three miles of canal, brings the waters of the Broad River to power houses on the Congaree River, where it is utilized under an average head of twenty-eight feet, generating under ordinary conditions about 10,000 horsepower, the greater part of which is utilized by means of electrical transmission, in the cotton mills of Columbia and for lighting and street-railway purposes. This location is susceptible of a larger power development by building a dam across the Congaree River, and thus utilizing the waters of the Saluda River also, the waters from the Broad River only being used at present.

(2) Property of the Central Carolina Power Company, which proposes to build a dam one mile above the mouth of Little River, and pond the water up to Alston, a distance of about ten miles. The fall is thirty-one feet, the horsepower 10,000 primary and 10,000 secondary. This location is sixteen miles above Columbia.

(3) Parr's Shoals Power Company, just above Alston, where a development with about thirty-two-feet fall, and a large pondage, is contemplated. The drainage is from 4,600 square miles, and the location twenty-eight miles above Columbia.

(4) Union Manufacturing and Power Company, two miles above the crossing of the river by the Seaboard Air Line, where a twenty-four-foot development has been made, giving 8,000 horsepower, which is used in driving cotton mills in Union, twelve miles away.

(5) At Lockhart Shoals, about twelve miles above the Union Manufacturing and Power Company's dam, the river has a fall of fifty feet and a drainage area of 2,400 square miles. Part of the power is utilized with a thirty-foot fall to develop about 5,000 horsepower, which is used in driving the Lockhart Cotton Mills.

(6) Ninety-Nine Islands, owned by the Southern Power Company, where there is a fall of fifty-one feet available. The development of this power is now under way. It will form one of several powers developed by the Southern Power Company, all of which will be electrically connected by a system of transmission lines furnishing power to all of the large towns in the northern central part of South Carolina (Lancaster, Chester, Rock Hill, Yorkville, Gaffney, Spartanburg) and to a number of towns in North Carolina.

(7) At Cherokee Falls, near the crossing of the river by the Southern Railway's main line, the fall is fifty feet. A power company has made arrangements to develop a large power at this point.

These powers of the Broad River do not account for 250 feet of fall within South Carolina, much of which is yet to be developed by capitalists at other points than those here mentioned.

ON THE SALUDA RIVER.

On this river there are the following notable powers:

(1) Saluda Factory and mouth of the river. There is about twenty-six-feet fall here, and the drainage area is 2,350 square miles, but this fall could best be utilized in connection with the Columbia Canal, as above mentioned.

(2) Dreher's Shoals, about ten miles above the mouth of the river, where it is proposed to build a fifty-foot dam and develop 10,000 horsepower. Drainage area is 2,200 square miles.

(3) From Long's Ferry up the river for fifteen miles, there are a series of shoals, giving a total fall of eighty-nine feet, which could be utilized in one or more developments that would furnish 20,000 horsepower.

(4) The next power of any importance is at Ware Shoals, where there is a development utilizing sixty-five feet fall and furnishing 6,000 horsepower which is partly utilized by the Ware Shoals Manufacturing Company's cotton mill.

(5) The Belton Power Company, which utilizes about forty-feet fall, is developing approximately 4,000 horsepower for use in cotton mills at Belton, Williamston and Anderson.

(6) The Pelzer Manufacturing Company has two developments, the lower with forty feet fall, furnishing 5,000 horsepower for electrical transmission to its mills, and an upper development with twenty-six feet fall, driving mills No. 1 and No. 2, and developing 2,500 horsepower.

(7) The Piedmont Manufacturing Company, which utilizes twenty-four feet fall in its cotton mill.

(8) The Saluda River Power Company, above Greenville, has made a development which furnishes power to some mills in Greenville.

These powers mentioned as on the Saluda River do not account for 450 feet of its total fall, much of which could be developed yet.

ON THE WATEREE (OR CATAWBA) RIVER.

The Wateree and Catawba rivers have six valuable powers, all of which are owned by the Southern Power Company, of Charlotte, N. C. These powers are as follows:

(1) Wateree Canal, just above Camden, where there is a fall of fifty-two feet and drainage area of 4,376 square miles.

(2) Rocky Creek, Great Falls and Fishing Creek—these three falls have a total fall of 173 feet. The development of Great Falls has just been completed and the others will be undertaken so soon as demand for power warrants.

(3) Landsford, near Lancaster, is the next power where there is a fall of forty feet.

(4) Catawba comes next, where the Southern Power Company has had a 10,000-horsepower plant in operation for several years, furnishing power to Rock Hill, Fort Hill, Pineville and Charlotte.

The powers mentioned do not cover 100 feet of the river's fall, some of which could probably be developed, especially

between the Wateree Canal and Rocky Creek.

ON THE SAVANNAH RIVER.

The Savannah River furnishes a considerable number of powers:

(1) Augusta Canal, forty-five feet fall.

(2) Blue Jacket and Little River Shoals.

(3) Twin City Power Company, which proposes to develop thirty-three feet fall, with a possible development of fifty feet.

(4) Calhoun Falls, where there is a fall of seventy-five feet. This is one of the biggest powers in South Carolina, and a company has been formed looking to its development. It is owned by J. C. Calhoun, of New York.

(5) Cherokee Falls, the property of the Savannah River Power Company, where it is proposed to develop 6,600 horsepower under a head of twenty-six feet.

(6) Gregg Shoals, owned and developed by the Savannah River Power Company—fall, 13.6 feet; 3,000 horsepower. Power is transmitted to Anderson, Abbeville, Greenwood and Calhoun Falls through sixty-five miles of line at 23,000 volts.

(7) Middleton's Shoals, where there is a fall of eighteen feet.

(8) McDaniel's Shoals, where there is a fall of thirty feet.

(9) Andersonville, fall unknown, but said to be a very valuable property.

TRIBUTARY RIVERS.

The meagreness of the data available regarding the shoals on the rivers tributary to those given above, prevents any definite description of them, except that the United States Government Surveys give some approximate data regarding the streams in the northwestern portion of the state, from which the following are taken:

Enoree River.—The Enoree River is the first tributary to the Broad River and has a drainage area of 730 square miles and a fall of 573 feet, or about seven feet to the mile. The available powers are: (1) Musgrove Mill, fall about ten feet, drainage area 400 square miles; (2) Yarboro's Mill, fall 16 feet, drainage area 400 square miles; (3) Long Shoals; (4) Enoree Mills, fall seventy feet, utilized for driving cotton mill; (5) Van Patton Shoal, fall fifty-five feet, development commenced; (6) Pelham Mills, fall eighteen feet.

Tyger River.—The Tyger River has a drainage area of 720 square miles and a fall of six or seven feet to the mile. Its powers are small, and there are only four developments on it, according to Civil Engineer Shand, before referred to; two are at Tucapau for the Tucapau Mills, and one at Appalachee, where 2,000-horsepower wheels have been put in to operate under a forty-seven-foot head, and at Fairmont for the Tiger Cotton Mills. There must be several good powers on this stream and its headquarters capable of furnishing several hundred horsepower. At Hill's Factory, between Union and Laurens, there is a fall of forty feet, which should be of value. The drainage area at this point is 308 square miles.

Pacolet River.—The Pacolet River drains 475 miles and has an average fall of six or seven feet to the mile. In its upper part the bed of the river is very precipitous, furnishing many good powers. The Pacolet Manufacturing Company utilizes a sixty-foot fall in its mills and the Clifton Manufacturing Company a twenty-two-foot fall. The Mary Louise Mills, near Cowpens, have a developed power on this river, and J. B. Cleveland owns two powers, one at Big Island, a thirty-five-foot fall, and one at Flat Rck, a twenty-eight-foot fall.

Saluda River Tributaries.—The Saluda River has several tributaries with good powers. Twelve-Mile Creek, in Lexington County, has a heavy fall and drains a sandhill country, from which the runoff is regular and large. The Lexington Manufacturing Company uses a twenty-six-foot fall, generating 200 horsepower, and between its plant and the river there is much available power for small manufacturing plants. Other tributary creeks from these same hills must also furnish many small available powers. The Reedy River, a tributary of the Saluda, has a drainage area of 386 miles, that has a very heavy fall. There are many small powers on this stream. The first is at Boyd's Mill, where a fifty-foot development, giving 1,000 horsepower, is proposed. Above this, there are many undeveloped falls or shoals. The largest power on the upper part of the stream is at Greenville, where there is a total fall of over eighty feet, the greater part of which is used in several manufacturing plants.

Tributaries of Wateree and Catawba.—The only notable tributaries of the Wateree and Catawba rivers are as follows: Pine Tree Creek, near Camden, on which the Hermitage Cotton Mills has a development. Fishing Creek, in Chester County, on which there have been several small developments of from fifty to 100 horsepower. Congaree Creek, a tributary of the Congaree River, is a Sand Hill stream, with a good fall and even flow, on which several good small powers could be developed. The Saxe Gotha Mills, on one of its tributaries, utilizes fifty horsepower. There are several small powers on these streams suitable for local use.

Tributaries of Savannah River.—The tributaries of the Savannah furnish a large number of powers about which little detail is known, but the following will give the total power in these streams, figuring one-half of the total fall for the full drainage area:

At Bath, seventeen-foot fall, 600 horsepower; at Langley, twenty-two-foot fall; at Graniteville, forty-three-foot fall, 600 horsepower; at Vaucluse, forty-eight-foot fall, 400 horsepower. These four powers are on the Big Horse Creek, and the amount of power developed covers practically all available.

In addition to these four on Big Horse Creek, there is a fall of thirty-five feet with 1,000 horsepower at Big Island and a fall of twenty-eight feet and 800 horsepower at Flat Rock, the property of J. B. Cleveland, before referred to. The horsepower is given approximately only, and generally indicates the horsepower claimed by the owners of the property.

Chattooga River.—To mouth of West Fork River, 3,500 feet fall, 8,072 horsepower; to mouth of Stekoa Creek, 400 feet fall, 3,076 horsepower; to mouth of Tallulah River, 100 feet fall, 1,582 horsepower; to mouth of Panther Creek, 100 feet fall, with 2,183 horsepower; to mouth of Chauga River, 150 feet fall, with 4,098 horsepower.

Tugaloo River.—To mouth of Choaster Creek, fifty feet fall, 1,700 horsepower; to junction with Seneca River, thirty-three feet fall, 1,289 horsepower.

Chauga River.—To junction with Tugaloo River, 1,050 feet fall, 1,569 horsepower.

Whitewater River.—To mouth of Big Eastatoe Creek, 3,200 feet fall, 14,954 horsepower.

Keowee River.—To mouth of Little River, 150 feet fall, 1,524 horsepower.

Seneca River.—To junction with Tugaloo River, 108 feet fall, 3,626 horsepower.

Little River (Abbeville County).—To mouth of Long Cane Creek, 425 feet fall, 4,431 horsepower; to junction with Savannah River, sixty-five feet fall, 1,405 horsepower.

Little River (Oconee County), 750 feet

fall, 2,302 horsepower. Twelve - Mile Creek, 975 feet fall, 3,792 horsepower. Conneross Creek, 725 feet fall, 1,681 horsepower. Eighteen - Mile Creek, 540 feet fall, 831 horsepower. Twenty-Three-Mile Creek, 450 feet fall, 839 horsepower. Twenty-Six-Mile Creek, 450 feet fall, 738 horsepower. Big Generostee Creek, 300 feet fall, 619 horsepower. Little Generostee Creek, 300 feet fall, 247 horsepower. Rocky River, 540 feet fall, 3,423 horsepower. Long Cane Creek, 375 feet fall, 1,752 horsepower.

The data given in this article cover about all that is known at this time regarding the waterpowers of South Carolina. A perusal of this article, together with the list of cotton mills in South Carolina operated wholly or in part by water-power, given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of January 9, covers the present situation in that state.

This review is made based on data and figures, kindly furnished the writer by Hon. E. J. Watson, Commissioner of Agriculture and Immigration, of South Carolina, and from a report made by Civil Engineer G. E. Shand, to both of whom credit is gratefully acknowledged.

Electrical Apparatus of St. Clair Tunnel.

Before the recently electrified St. Clair tunnel was delivered into the hands of the railway it was operated by the contractors for a period of several months, in order thoroughly to test the electric apparatus. A report on the operation of the railway during this period has recently been published. This report shows that the electric locomotives handled 1,000-ton trains, as against 700-ton trains with steam locomotives. The electric trains, numbering on the average 27.3 cars per train, made the run of the electrified section in ten minutes, as against steam trains averaging 19.7 cars, which required fifteen minutes for the same distance. The steam locomotives consumed nearly $5,000 worth of coal per month, as against $1,150 per month for the electric service, the reason for this difference being that steam locomotives had to burn hard coal costing $6 a ton, while soft coal at $2 a ton may be used in the power station.

The Rubber Industry in Mexico.

Consul W. W. Canada, of Vera Cruz, Mexico, in a consular report, gives some interesting notes on the rubber industry in Mexico, which is not proving so profitable as was expected. Copies of this report may be obtained from the Bureau of Manufactures, Washington, D. C.

The Application of Alternating Currents to Modern Steamship Requirements.

In a recent paper read before the (British) Institute of Marine Engineers, John McLaren strongly advocated the use of alternating-current installations for various purposes on ships.

A system of gas-driven electric generators and motors was proposed, which would do away with the donkey boiler and its steam and exhaust pipes and accessories. The engine-turning gear, the multifarious pumps and fans, the ash hoists, steering gear, refrigerator plant, and many other devices at present operated by steam, could be more efficiently and satisfactorily operated by alternating-current motors. Moreover, the gas-electric generating plant would require only a few moments to put it into operation, whereas much time is wasted under present conditions in getting up steam, or much money is thrown away by keeping up steam when it is not wanted.

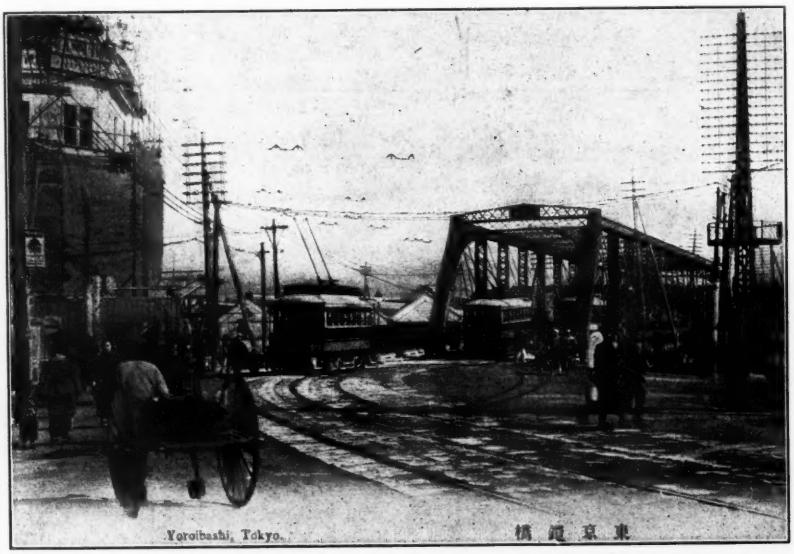
Alternating currents do not affect the compass, and alternating-current motors are practically unaffected by weather conditions at sea.

The author suggested that the total cost of installation of his proposed system should be less than that of the present type, but he did not go further into this question. He did point out, however, that a direct-current set would be prohibitive in cost, owing to the motor transformers necessary to reduce the direct current to a working pressure, and the complicated system involved.

The use of a suction gas engine and the flywheel type of alternator was recommended for the generating set, and the polyphase type for the motors. The advantages of the latter are obvious for shipboard use, as it is self-starting, operates practically at constant speed from no load to heavy overloads, and develops very nearly its maximum torque in starting at full load. This latter condition is very necessary in operating winches, pumps, fans, etc.

The author pointed out that the three-phase, three-wire system should be adopted, owing to having a combined power and lighting load, to the saving in copper effected, and to other economies, including that of space taken up by the machinery.

Mr. McLaren proceeded to discuss the amount of power required to operate the auxiliary machinery in certain specific cases and the details of the electric installation required therefor. Some interesting particulars were adduced.



STREET SCENE, YOROIBASHI, TOKIO, JAPAN.

A Souvenir from Tokio.

The accompanying illustration is from a photograph of one of the main streets in Yoroibashi, Tokio, Japan. Under date of March 17, C. G. Young, who is making an extended trip in the far East, writes that the transforming of Japan is not conducive to its artistic betterment, but that improvements like steam heat are appreciated when, like on the day the card was mailed, it was snowing very heavily. Mr. Young reports that passenger traffic is heavy in Yoroibashi, and that the fares are low, the average single fare being four sen (a sen is equivalent to one-half cent).

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDWARD R. WOLCOTT.

CHAPTER IX. (PART I.)—MEASURING INSTRUMENTS.

The principles made use of in the construction of instruments for measuring currents and potentials are, in general, as follows:

1. Magnetic action of a solenoid on iron.

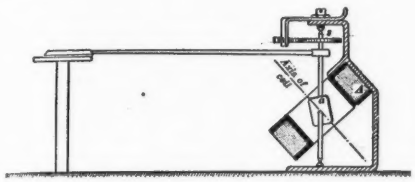


FIG. 170.—THOMSON INCLINED-COIL AMMETER.

2. Magnetic action of one solenoid on another.
3. Action of a permanent magnetic field on a solenoid.
4. Electrostatic action of one charge on another.
5. Electrolytic action of a current.
6. Expansion due to heating.
7. Inductive action of an alternating current on a conductor.

The third and fifth methods are not adaptable to alternating-current instruments.

Soft iron instruments.—There are two ways in which the action of a solenoid on iron may be applied to electrical measurement; the iron may be fixed and the solenoid movable, or the solenoid may be fixed and the iron movable. Either of the above methods can be used for the measurement of alternating currents unless the iron be magnetized, in which case they are suitable only for direct-current measurement. The former method is not used in practice.

The solenoid and plunger type of instrument was one of the early forms. It consists simply of a solenoid carrying the electric current and a piece of soft iron carrying a pointer and so suspended as to be drawn into the solenoid on the passage of the current. The magnetic lines of force, generated within the coil by the current, exert an attractive force upon the iron no matter which way the current is flowing through the coil. A pointer is attached to the plunger and it moves over a calibrated scale as the plunger is drawn into the solenoid. The scale is calibrated by testing with a current of known strength, if it is to be used as an ammeter; if the coil is of high resistance for use as a voltmeter, it is compared with known potential differences. The plunger is counterbalanced by a weight or a spring so that the pointer will return to zero when the current is discontinued.

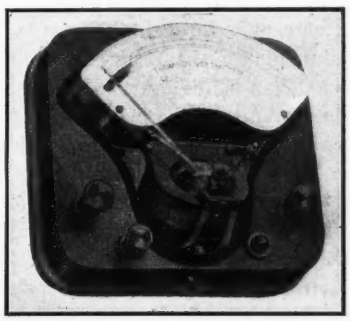


FIG. 171.—THOMSON INCLINED-COIL VOLTMETER.

Magnetic vane instruments.—The magnetic vane instrument differs from the above in that a rotatable iron vane is so mounted within the solenoid that as the current through the latter increases the

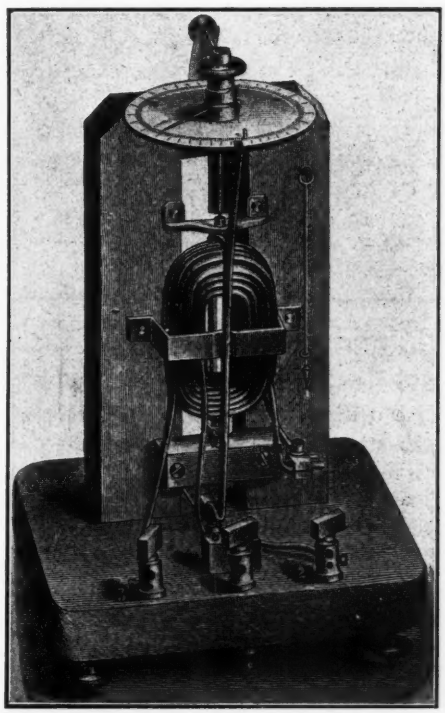


FIG. 172.—SIEMENS ELECTRODYNAMOMETER.

vane seeks a more favorable magnetic position—and the attached pointer moves across the scale. In the Thomson inclined coil instrument, illustrated in Figs. 170 and 171, the small vane of soft iron *a* rotates about a vertical axis that makes an angle with that of the coil. When the attached pointer *b* is at its zero position the vane lies partly across the path of the lines of force; as the current is turned on it tends to assume a position parallel to the lines of force. When used for direct currents these instruments are affected by stray magnetic fields or masses of iron in close proximity. However, a fairly accurate reading can always be obtained by reversing the direction of the current without changing the position of the instrument and taking the average of the two readings.

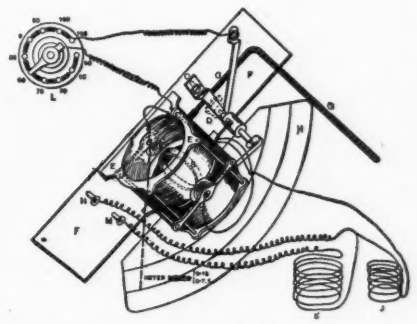


FIG. 173.—MECHANISM OF WESTON ALTERNATING-CURRENT VOLTMETER.

In the Hoyt magnetic vane instruments the vane of soft iron tends to move under the influence of the magnetic field generated by the current, but is held in position by turning a torsion head, the magnetic action of the field on the vane being balanced by the torsion of two small springs. A pointer is attached to the torsion head. As the current through the coil increases the action on the vane is stronger; the torsion head and the attached pointer must be turned to maintain the vane in its original position. The instrument is calibrated so that the position of the pointer indicates the value of the current or the electromotive-force as the case may be.

Electro-dynamometer.—The action of one solenoid on another is made use of in measuring either alternating or direct currents and an instrument embodying this principle is shown in Fig. 172, which is the Siemens electro-dynamometer. One coil, consisting of many turns and divided into two parts, is mounted on the upright frame as shown. Connected in series with this double coil is suspended a coil of only one turn, the zero position of which is such that its plane is at right angles to that of the coil of many turns. It is suspended by means of a fine thread, which is connected to a coiled spring and a torsion head. No matter which way the current flows the deflection of the suspended solenoid is the same unless its

connections with respect to the fixed coil are changed. The suspended coil is brought back to its zero position on the passage of a current by means of the torsion head; the pointer attached to the latter indicates the reading.

A double coil is used to increase the range of the instrument; when a large

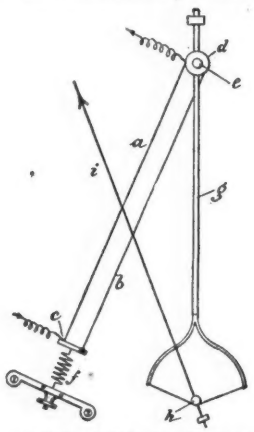


FIG. 174.—MECHANISM OF HOT-WIRE INSTRUMENT.

current is to be measured the heavy coil of fewer turns, is used, and vice versa.

The Weston alternating-current instruments are constructed according to this principle, as are most indicating wattmeters. The connections of a Weston alternating-current voltmeter are shown in Fig. 173. There are two scales, one low and one high-reading, either of which can be used by changing the connecting terminal. Correction can be made for temperature variations by the adjustment of the thumb-screw at the top, which varies a series resistance.

Hot-wire instruments.—Hot-wire instruments are built in such a way as to indicate the expansion of a wire which is being heated by an electric current. The

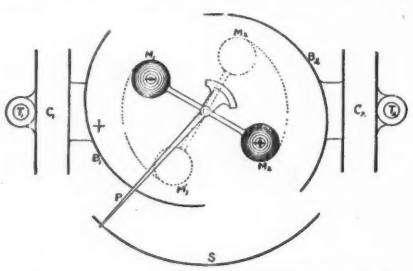


FIG. 175.—PLAN OF ELECTROSTATIC VOLTMETER.

heating being proportional to the current, the expansion due to the former can be used to indicate the latter. The method of operation of a Roller hot-wire instrument is shown in Fig. 174; *a b* is a non-oxidizable wire of high resistance and low temperature coefficient, which is wound around the pulley *d*, its ends being fastened to the plate *c*. The slack in the wires on heating is taken up by the spring *f*, which is also attached to the plate *c*. The arm *g* is attached to the shaft *e*, on which the pulley *d* is secured. Between the forked arms at the end of *g* is stretched a silk fiber, passing over a pulley *h*, on which is fastened the pointer *i*. Thus any relative movement of the two wires is greatly magnified. The current flows only through the wire *a* and not through *b*; the former expands so that pulley *d* moves arm *g* and the pointer *i* moves over a calibrated scale. If the temperature of the surrounding air increases, both *a* and *b* expand, the spring *f* taking up the slack so that the pointer does not move, thus making excellent temperature compensation.

Electrostatic voltmeters.—Electrostatic instruments are based upon the mutual

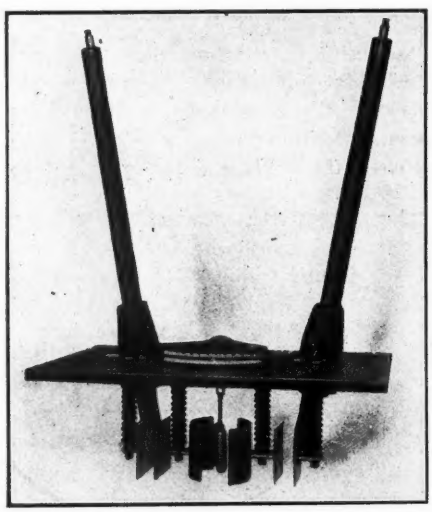


FIG. 176.—VITAL PARTS OF WESTINGHOUSE ELECTROSTATIC VOLTMETER.

attractions and repulsions of unlike and like charges of electricity, and are particularly suitable for measuring the potential of high-tension circuits. Fig. 175 shows diagrammatically the principle of the electrostatic voltmeter illustrated in Fig. 176. T_1 and T_2 are terminals, C_1 and C_2 are two condensers, one plate of each being connected to the terminal and the other to the two curved plates B_1 and B_2. M_1 and M_2 are two hollow suspended cylinders mechanically connected and capable of rotating around a vertical axis. The pointer P is attached to them and moves over the scale S as the cylinders rotate. The condensers C_1 and C_2 become charged from the transmission line and the charges on the curved plates induce opposite charges on the hollow cylinders. The opposite charges attract each other and the cylinders are drawn to the position shown by the dotted line. These instruments are built to read voltages up to 200,000 volts and are intended primarily for testing and experimental purposes. That part of the instrument below the scale is enclosed in a metal-lined wooden box filled with oil. The oil serves not only for insulating purposes, but lu-

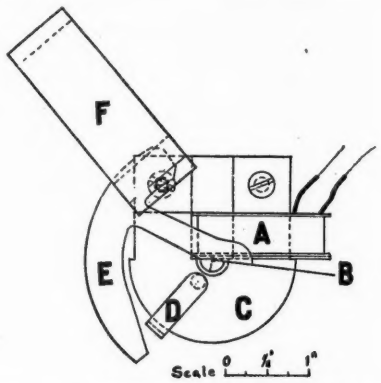


FIG. 177.—DETAILS OF REPULSION-TYPE INSTRUMENT.

bricates the movement and renders it dead beat. The metal lining screens the instrument from the effect of external electrostatic fields.

Induction-type instruments.—The principle of induction is made use of in some alternating-current ammeters. A fixed coil carries the current and adjacent to it is a movable disc of some light conductor, such as aluminum, which carries the pointer. Currents induced in the disk react with the magnetic field set up by the coil, thus causing a movement of the pointer that is opposed by a spring.

A modified form of the induction-type instrument is the repulsion type. In this

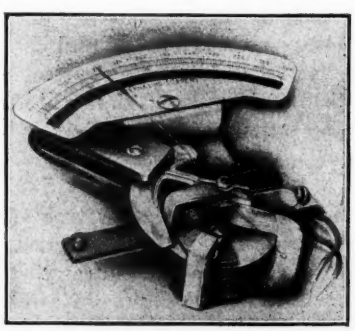


FIG. 178.—INTERNATIONAL REPULSION-TYPE INSTRUMENT.

the torque is produced from the direct repulsion between a primary and a secondary or induced current without the use of a rotating magnetic field. Illustrations of such an instrument are shown in Figs. 177 and 178. In the former figure A represents the primary coil and B the movable secondary coil of a short-

circuited transformer, the laminated iron core of which is represented by C. On the passage of an alternating current through the primary, a current is induced in the secondary and tends to move under the influence of the mutual repulsion of the two coils. This movement is opposed by two spiral springs. D is an adjustable

FIG. 179.—WESTINGHOUSE FREQUENCY METER.

coil used to increase the sensitiveness of the instrument. The vane E, which is connected to B, swings freely between the poles of a permanent magnet F, which dampens the movement of the needle because of the induced eddy currents.

Frequency indicators.—The frequency of an alternating current can be easily calculated from the speed at which the generator is running and the number of pairs of poles, but variations in the frequency are not readily obtained in this way, and the generator is not always accessible.

An instrument for indicating the frequency is illustrated in Fig. 179. It consists of two voltmeter coils, one in series

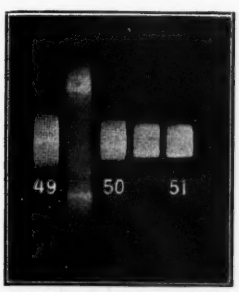


FIG. 180.—REEDS OF FREQUENCY METER IN VIBRATION.

with a non-inductive resistance and the other with an inductive resistance. These two act in opposite directions upon a rotating shaft carrying a pointer. The shaft therefore takes up a position where the torque of one coil balances that of the other. As has already been shown, the frequency affects the value of the reactance of an inductive coil and a change in frequency would therefore change the value of its current and of the torque due to that coil and thus cause a shifting of the pointer. The scale over which the pointer moves is calibrated to read frequency directly in cycles per second.

The principle upon which another type of frequency indicator is constructed is that of resonance. A row of steel strips or reeds, each having a free period of vibration differing by one or one-half vibration per second from its neighbor, is arranged so as to be acted upon by a magnet through which flows the current whose frequency is to be determined. The fluctuating attractive and repulsive action of the coil sets into free vibration that reed having the same period, or into partial vibration adjacent reeds having nearly the same period. The reeds as viewed from the end appear as shown in Fig. 180, which represents a set of reeds differing from each other by one-half vibration per second. As can be seen the reed representing 49.5 is vigorously actuated, 49 much less and 50 only a small amount, showing that the frequency is a little less than 49.5. In this particular case it was actually 49.4. A good view of one of these frequency meters was shown in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of January 16, 1909.

Fenders Ordered in New York City.

The New York Public Service Commission has issued orders to all the street railroad companies in Manhattan, Brooklyn, the Bronx, Queens and Richmond to equip all their cars, except those operated by animal power, with wheel guards or fenders approved by the commission.

The Manhattan and Bronx companies must have guards installed on all cars by August 1. The Brooklyn and Queens cars are to be equipped with fenders by July 1. The Staten Island Midland Railway Company and the Richmond Light and Railway Company are ordered to install both guards and fenders by July 15.

In each of these cases drawings and specifications for the equipments are to be submitted to the commission for approval. In the year ended December 31, 1908, the total number of injuries on the lines under consideration was 35,050, which included 2,137 seriously injured and 434 killed outright.

It is calculated that it will cost between $200,000 and $250,000 to equip the 6,000 cars in use in the five boroughs. The total cost of law suits and legal expenses arising from injuries has been $3,500,000.

Electric Fire Boats Prove Their Worth.

Much has been written about Chicago's new electric fire boats, made by the Manitowoc Dry Dock Company, and famous on account of their double turbine equipment.

The boats have been in the Chicago River for some months past, but had not been called into service until the bad fire of April 29, when several grain elevators near the mouth of the river were destroyed. The fact that the fire did not spread far and wide over that section of the city was attributed to the work of the "Graeme Stewart" and "Joseph Medill," the sister boats, driven by Curtis turbine engines, furnished by the General Electric Company. It was 4:30 in the morning when the "Graeme Stewart" answered the first alarm, and almost immediately she was in service with full pressure on the two gun nozzles, firing huge streams of water from the turrets.

It is a source of great satisfaction to record the success of these turbine fire boats, as they were the first of their kind, though the design and build is now being copied in Paris and other large cities.

Metropolitan Sale June 1.

June 1, 1909, has been fixed as the date for the sale of the property belonging to the Metropolitan Street Railway Company, in accordance with the decree of the United States Circuit Court in the action brought by the Guarantee Trust Company of New York. Joseph P. Day has been designated as the auctioneer.

He will offer the property for sale at the north main entrance of the County Court House, New York city, at 1 o'clock on the day mentioned. His instructions from the court are to sell the property as an entirety. No bids will be received from any bidder who has not first deposited with the special master $100,000 in cash, or a certified check for that amount.

Havana Telephone Company Acquires Government Lease.

The Havana Telephone Company, whose contract with the government of Cuba expires next year, has surrendered its right under this contract and has obtained a lease from the government for eighteen years, the company to pay the government $24,375 a year for the first two years and $150,000 for each of the remaining years.

This arrangement is made by a presidential decree, although Congress is in session.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION.

THIRD ANNUAL CONVENTION AT SPRINGFIELD, MO., APRIL 15, 16, 17.

The third annual convention of the Missouri Electric Light, Gas and Street Railway Association was held at the Colonial Hotel, Springfield, Mo., on April 15, 16, 17 last.

The convention was called to order by President W. B. Hays at 10:30 a. m. on Thursday, April 15. A very cordial address of welcome was read by Mayor Ernst of Springfield, in which that gentleman related in a topical way his experiences of the phenomenal growth of things electrical. The president replied in a neat little speech, and then continued with his annual address, in which he briefly related the history of the association from its organization on October 21, 1907, in St. Louis, with a membership of twenty, up to the present time, when the number of members is over fifty. The rest of the morning session was occupied with general business matters.

INSURANCE ON PUBLIC-SERVICE PLANTS.

The Thursday afternoon session was opened by C. W. Hough, of Joplin, with a paper entitled "Insurance on Public-Service Plants," a digest of which follows:

The author investigated the insurance problem as applied to electric-light, railway and telephone companies, and found that some carried no insurance, because of high rates, while others carried an insufficient amount for the same reason. There was a lack of intelligent classification, which resulted in general dissatisfaction and a demand for more equitable and economical methods.

This led to a plan evolved by the author, who is the general manager of the Consolidated Light, Power and Ice Company, of Joplin, in conjunction with Judge Hoag, the secretary of that company, for the formation of a mutual insurance exchange among electrical companies. Up to the present a total of $400,000 worth of insurance has been subscribed, and this will be increased under the present plans to a maximum of $1,000,000. The cost of insurance is the amount of actual losses paid out, plus a charge of twenty-five per cent of the premium deposit for operating expenses. The author mentioned that insurance exchange was not an experiment, but had been successfully practiced in other lines of business for about twenty years.

In the discussion that followed, the president and several of the members heartily recommended the mutual insurance-exchange idea, and some affirmed that they had, to their great advantage, replaced their old insurance by Mr. Hough's scheme.

THE TUNGSTEN LAMP.

Paul M. Loewe, of the Moberly Gas and Electric Company, followed with a paper on "The Tungsten Lamp from the Central-Station Manager's Standpoint." The author told of his experiences as a central-station man in successfully installing the tungsten lamp. He deprecated the prevalent idea that this lamp meant a loss of revenue to the central stations. In fact, it was rather the reverse, for the customer usually increased his illumination and his time of using it, on account of the much greater efficiency of the new lamp. Several reasons were adduced for using the tungsten lamp, and the author asserted that with proper care its life should equal, if not exceed, that of the carbon lamp. He instanced one of his sixty-watt tungstens that had a life of 960 hours as proved by actual test.

The advantages of Holophane shades, which were about contemporaneous with the new lamp, were then extolled and Mr. Loewe called attention to the help central-station men could obtain from the tungsten-lamp companies and the makers of these shades in disposing of their wares.

The author gave some instructions how to interest all classes in electric lighting, showing how the brilliancy and economy of the new lamp gave them a weapon they had not before possessed in approaching people who had hitherto been deaf to their advances. Especially was this the case with those who were using coal-oil and gasoline lighting plants.

Convincing data were brought forth showing the tungsten lamp to be the superior of the gasoline-lighting system.

A lively discussion followed, in which the members present gave some of their experiences on the subject. Mr. Clary said that his company was operating tungstens in series with arc lamps and that since he had adopted the plan of employing tungstens of one-tenth of an ampere greater capacity than the current used on his system, he now experienced no trouble whatever from short-lived lamps. Mr. Irvine volunteered the information that since the introduction of the tungsten he had pushed the use of electricity for lighting and had endeavored to confine the use of gas for fuel purposes only. Mr. Hough, in his town, found the tungsten a good competitor with natural gas at twenty-five cents a thousand. Other speakers followed with remarks on the first cost of tungsten lamps and the charges for renewals. Mr. Irvine renewed tungstens on a flat-rate basis, and the consensus of opinion was that it was good policy to sell the lamps at about cost in order to get the customer to use the electric illumination.

Before the adjournment, a discussion arose on the advisability of having an exhibit of manufacturing concerns at future conventions, and it was proposed and carried that this be done for the next convention.

EQUITABLE RATE-MAKING.

The Friday morning session opened at ten o'clock with a paper by C. W. Hough, entitled "Equitable Rate-Making." This valuable and timely paper was an analysis of the statistics of the last United States Census Report on the Electrical Industry, showing central-station investment and operating costs and the application of the figures adduced to the methods of charging for electrical current, with especial reference to the Doherty readiness-to-serve system. This paper and the instructive discussion which followed will be abstracted in a later issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

THE VALUE OF AN ENGINEERING EQUIPMENT STATION.

Prof. H. B. Shaw, dean of the Engineering School of the University of Missouri, opening the Friday afternoon session, read a paper on "The Value of an Engineering Equipment Station." The author commenced his paper with a brief account of the efforts toward interesting the government in the matter of establishing engineering experiment stations at land-grant colleges, and of a bill introduced in Congress to this effect. Conservation of natural resources, with some figures on more or less preventable fire losses, afforded a topic for considerable discussion, which the author considered at some length.

The probabilities of the exhaustion of the visible coal supply were then touched upon, but the author was optimistic when speaking of the potentialities of our waterpowers which were capable of much further development. It was necessary in order to conserve these waterpowers that conservation of the forests must be at-

tended to and recourse had to reforestation when necessary.

The author quoted from a report of the New York State Water Commission, showing the yearly damage ($3,000,000) by floods in New York state, the probable annual profits ($18,000,000) of total waterpower utilization in the state, and the annual saving in coal (12,000,000 tons) in New York city by the transmission of 1,000,000 electrical horsepower for manufacturing purposes.

Quoting further, it is estimated that of 30,000,000 horsepower in the United States, about 9,000,000 is utilized electrically. There is about 150,000,000 developable horsepower in waterpowers in the country. To develop 30,000,000 horsepower from coal requires about 225,000,000 tons of coal a year in the best plant and more than 650,000,000 tons of coal in the average plant, which, at $3 a ton, would cost about $2,000,000,000!

Efficiencies were then discussed and figures were given from tests by H. C. Stott of a steam-electric plant. These appeared in Mr. Stott's paper before the American Institute of Electrical Engineers, January, 1906. This plant gave an efficiency of 10.3 per cent. Average results for other plants were also shown. Professor Shaw asserted that probably the average over-all efficiency of all plants throughout the country does not exceed five per cent, and that when one considers that only a few per cent of the power produced is converted into light the astounding conclusion presented itself that on the average over ninety-nine per cent of the coal energy in our electric plants is now constantly being wasted. This afforded a tremendous field for research and investigation toward retrenchment and economy, which showed the necessity for the engineering experiment station.

The author then briefly outlined the functions and duties of such institutions and proceeded to give detailed accounts of the work done at the experiment stations already established at the University of Illinois and at the Iowa State College.

In conclusion Professor Shaw said that continuous experimentation and investigation are required to utilize properly and to conserve our natural resources and to obtain the best results in our engineering industries.

A short discussion followed.

HIGH-TENSION TRANSMISSION.

O. Weimer, of the Wagner Electric Manufacturing Company, was unavoidably absent and his paper, "Some New Features of High-Tension Transmission," was read by one of the members. This was an account of some high-tension transmission plants from personal observations during a recent trip through the West. The following is an abstract of the paper:

"The transmission voltage of the Telluride system in Utah is at present 40,000 volts (three-phase, delta-connected), but it is the intention to change over eventually to 80,000 volts. A large part of the transmission lines have already been reconstructed to take care of the higher voltage, and all the newer transformers are arranged for 40,000 to 80,000-volt connections on the high-tension side.

"The generation and, with a few exceptions, the local distribution, are at 2,300 volts.

"There is one interesting feature which the Telluride company has indorsed and carried out more elaborately than any other concern. The Telluride Institute at Olmsted is an institution similar to our larger technical universities, except that only employes of the Telluride company are eligible. Most of the younger employes are getting a technical education along with practical experience.

"The Institute has a beautiful new building which is used for recitation and lectures. There is a large reading room and library which contains many scientific electrical books as well as magazines, etc. The physics laboratory contains quite an elaborate equipment, much of which is made in the shops.

"In their experimental laboratory, which is a separate building, they have constantly under way development work along the line of lightning arresters, insulators, etc. This company has developed for its own use a very interesting lightning arrester, which is a modification of the horn-type principle. One of the horns is insulated in an air chamber, so arranged that the arc is rapidly blown out by the aid of a small blower outfit. This construction appears to be expensive and difficult to maintain in repair, but if this apparatus successfully solves the difficulties which it was designed to meet it would be economical at any price and will be subject to more or less general adoption.

"Near the laboratory is a small building which contains a high-tension testing transformer. The principle feature in the construction of this transformer is the use of a single bushing in the middle of the cover to bring out only one of the high-tension leads. The other high-tension lead is grounded inside of the case, and one of the testing terminals is likewise grounded for testing insulating materials and high-tension apparatus. While the capacity of this transformer is small, some interesting investigations have been carried out and with voltages in the neighborhood of 150,000 volts.

"The Battle Creek station is a new plant which is used as a regulating station to take care of the peak loads. This plant is interesting because it represents the most modern methods for power plants using a high head of water. The effective head is nearly 2,000 feet. The principal idea which has been carried out in the arrangement of the equipment is simplicity of control. One operator can stand in front of the switchboard and regulate the load by the generator-field rheostats or by deflecting the two nozzles of the Pelton wheel independently. It requires only a few minutes to start up the generator and throw it in the line.

"The power station at Jordon Narrows gives an excellent example of the old type of power plants operating under low heads of water. The equipment is interesting by way of comparison with modern design and construction. The transformers are substantially the same as when first installed. Improvised water jackets make it possible to overload these transformers beyond the capacity for which they were designed as self-cooled units.

"The Garfield station is the most interesting on account of the 80,000-volt equipment, which represents the latest practice in high-tension work.

"Switching stations are located at the principal junction points of the transmission system in order that the lines may be divided into sections for testing Wherever possible the lines connecting power plants and substations pass over separate routes to reduce to a minimum the probability of any two sections being affected simultaneously by extreme weather conditions. It is thus necessary for at least two lines to be out of commission at the same time before it is necessary to discontinue any station."

This concluded the author's remarks on the Telluride systems.

"The Edison Company is now operating a large plant on the Kern River, which takes care of their entire load, and the many other smaller waterpower plants as well as their large steam-turbine plant are used only for reserve power

in emergencies. This plant has a rated capacity of 20,000 kilowatts, which is transmitted at 75,000 volts to Los Angeles 150 miles away. A new plant on the Kern River is under construction.

"On the Pacific Coast the principal improvements are along the line of more permanent construction and more durable equipment. The reason is quite apparent when you think of the inaccessible location of some of the power plants and the great distances from the factories which supply the repair parts. It is natural, then, that steel towers are replacing the wooden poles and that tunnels through the mountains are replacing wooden flumes. But with all the modern improvements the provision for making repairs and the necessity for duplicate equipment cannot be overlooked.

"In conclusion, let us touch on some of the new features of transformer construction. The most marked improvement has been due to the introduction of alloy steel for increasing efficiencies. While much has been said about this new steel, its use is limited for much the same reason that the use of silver or platinum wire is limited for electrical conductors.

"The most important feature of transformer design is to provide for the insulation strains which result from lightning storms and line surges. Transformer designers have so far been able to keep ahead of transmission engineers.

"A new feature of transformer requirements is parallel operation. It is customary in large installations to equip substations with transformer capacity sufficient to take care of immediate needs, and as the load increases to install temporary smaller units until the load justifies duplicating the largest bank of transformers. The necessity of parallel operation characteristics is evident."

In the discussion that followed several speakers gave their own experiences on the subject of high-tension transmission, and the question of the substitution of aluminum for copper was brought up. In this connection, Professor Shaw remarked that the price of aluminum was fixed by that of copper, being ten per cent less than the latter metal. The lighter metal, he said, is used almost entirely in cables. The tensile strength of light aluminum alloys was being increased.

OFFICE SYSTEM AND ACCOUNTING.

The Saturday morning session opened at 9:30 a. m., with a paper by N. T. Cunningham, of the Springfield Gas and Electric Company, on "Office System and Accounting." This paper was professedly offered to promote a discussion on this important subject. Several members took advantage of the opportunity offered and gave interesting particulars of their own practice. Other papers read and discussed were "Records," by P. A. Bertrand, of Jefferson City, and "Advantages of Mechanical Stoking," by T. E. Gannett, of St. Louis.

During the convention many entertainments were provided for the members and visitors, including a complimentary banquet on Friday evening given by the supply men to the central-station men, and an automobile party on Friday afternoon to the Country Club.

At one of the executive meetings the rules of the association were modified so as to admit water companies, and the name of the association was changed to "The Missouri Electric, Gas, Street Railway and Water Association."

The following officers for next year were elected: President, W. A. Bixby, Springfield; first vice-president, R. J. Irvine, Marshall; second vice-president, F. E. Murray, Louisiana; third vice-president, P. A. Bertrand, Jefferson City; secretary and treasurer, C. L. Clary, Sikeston.

The Executive Committee consists of H. B. Hibbler, Washington; P. J. M. Loewe, Moberly; C. W. Hough, Joplin; and S. E. Bronson, Ozark.

The next annual meeting is to be held at Jefferson City, Mo., April 14, 15 and 16, 1910.

Arbitrating Lighting Rates.

Arbitration between a city and a public-service corporation has been concluded at Temple, Tex., in a manner which seems to be satisfactory to both parties; a noteworthy fact in connection therewith being that the two arbitrators appointed by each party did not find it necessary to submit a single detail under contention to the umpire which was agreed upon for rendering a decision in such cases.

The company had previously made a proposition for lighting the town at $3,240. After some discussion it was agreed to appoint arbitrators to decide what would be a fair price for the company to charge for the proposed service, namely, fifteen arc lights and eighty tungsten lights. The arbitrators, W. H. Wiggins of Waco, and R. B. Stichter of Dallas reported that a fair price for this service would be $3,750.30, about $500 more than the company's original proposition. This addition was principally due to the desire of the city to extend the lighting over a larger area, requiring twenty-two miles of new wires and poles as against ten miles originally contemplated; and because the lighting company had omitted from its calculations, by oversight, the cost of the water required in the steam plant, which the arbitrators estimate would cost 0.1876 cent per kilowatt-hour. Other items of cost of current were given as 1.7698 cents for fuel and 0.183 cent as pro rata cost of insurance, oil, waste, packing, etc. (The company is already engaged in furnishing commercial lighting.) The remaining items of cost for furnishing the number of lights stated were as follows:

Inspection, one-half of $900	$ 450.00
Electrodes at $1.70	25.00
Outer globes at 50 cents	7.50
Rectifier renewals	3.75
Incandescent renewals (1,000 hours)	292.00
Eight per cent on $10,402.72 investment for street lighting	832.22
Maintenance of lighting equipment	824.85
One-and-three-quarters per cent on $7,500 as taxes on new installation	131.25
55,588 kilowatt hours at 2.14 cents	1,189.58
	$3,757.30

The equipment going to make up the cost of $10,402.72, which was to install fifteen 310-watt luminous arc lamps and eighty sixty-candlepower series tungsten incandescent lamps, was as follows:

Arc and incandescent light equipment, rectifier, etc.	$1,979.76
Installation of rectifiers in station	52.00
Installing arc and incandescent lamps	347.70
New poles and provisions for old ones necessary for street circuits	2,099.84
Wires, insulators, hardware and labor	5,152.95
Incidentals and contingent expenses	770.57

The cost of generating electricity was based on a twenty-four test made in the power house of the company. The amount of current required was based on the assumption of an all-night and every-night schedule. In spite of the fact that this sum is higher than the original bid of the company, it appears from the above that no allowance is made for additions to the power plant (none being required at present) or for any percentage of the cost of the plant. It would appear, therefore, that even this increased price was very favorable to the city.—*Municipal Journal and Engineer.*

Committee to Consider Public Service Commission's Jurisdiction.

Resolutions providing for the appointment of a commission to inquire into the question of extending the jurisdiction of the New York State Public Service Commission to include telephone and telegraph companies were adopted by the New York State Senate on April 29. The commissions will sit during the legislative recess and report to the Legislature next year.

Electrical Installation of the City of Para, Brazil.

BY ALBERT H. BRIDGE.

Among recent centers that have benefited from the incoming of the electrical engineer with his converting and modernizing power, is the city of Para in Brazil. This famous Amazon River port has long been renowned for the high quality of its rubber and the extent of its great rubber industries. Its population has increased in less than twenty years from 70,000 to 150,000. Para is situated practically under the equator and its climate is necessarily hot, though nowadays the health of the inhabitants is comparatively good. The city is situated at about 120 miles from the mouth of the Amazon River, where the latter is some sixty miles wide and is obstructed by hundreds of islands. That the Para channel is the only reliable channel for steamer traffic is of immense importance to its commerce.

Formerly the tramways were operated by mules, and consisted of thirty-three miles of single track. They were all owned by the Urbana Company, although portions were laid to different gauges. The electric lighting was supplied by two companies, the Urbana Company furnishing all the public as well as the commercial lighting, while the Paranese Company was responsible for private lighting only. In 1905 a ninety-nine-year concession was obtained for the purpose of electrifying the tramways. The concession and the old mule tramways were purchased by the Para Electric Railways and Lighting Company of London, and the contract was given to J. G. White & Company for the complete reconstruction and installation of the tramways and lighting. Below is an outline of the work that has now been completed.

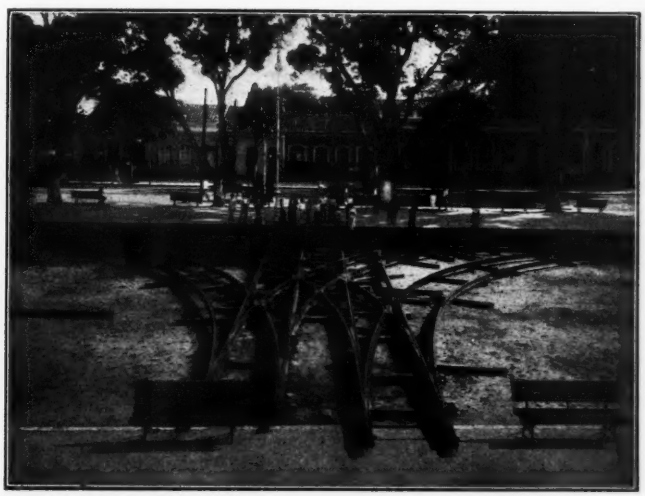
The total length of track constructed for electric working is 55,060 metres, of which 26,000 metres of single track are laid in paved streets, and 21,600 in unpaved streets, all with girder rail. A further 7,400 metres of single track were laid in unpaved streets with seventy-pound T-rails. Tie construction was employed throughout the whole of the work. The rails for straight track weighed ninety pounds per yard. At curves under 150 metres radius rails of ninety-six pounds per yard were employed. On all paved streets Thermit joints were used, tiebars being spaced seven feet 6 inches apart. On unpaved streets continuous joints were employed with two eight-inch concealed bonds per joint. The track is laid to a gauge of four feet eight-and-one-half inches. The ninety-pound rails consist mostly of forty-five-foot lengths, while the heavier rail is in thirty-three-foot lengths. All the girder rail was supplied by the Northeastern Steel Company of Middleborough, England.

The track is cross-bonded at every 100 metres, and intertrack bonds are spaced 200 metres apart. All crossings are bonded with two eight-inch concealed bonds and two long bonds, fourteen feet long. All points are bonded with two twenty-one-inch bent bonds and two long bonds fifteen feet long with a cross-bond fifteen inches long across the point toe.

The ties, which are made from a very hard Brazilian wood, are spaced two feet six inches from center to center. They rest on stone ballast of a depth of ten centimetres, and this ballast is brought up to the level of the top of the sleepers on all paved streets. In unpaved streets the sleepers rest on the same depth of ballast, but the ballast is brought to the level of the head of the rail and well rammed.

The ground upon which the city stands is practically level, but there is one short gradient of one in fifty-six. The smallest radius curve on the whole of the work is ten metres.

STREET SCENE, PARA, BRAZIL.



A TYPICAL JUNCTION FOR THE STREET RAILWAY.

With the exception of four kilometres of center-pole construction and three kilometres of side brackets, the whole of the overhead work consists of span construction. The junctions are made with galvanized mild steel span wire. Tubular steel poles are employed throughout. Of these there were at the beginning of the work about 1,400 in the city, which were used for carrying the lighting wires, and where possible advantage was taken of their presence for the purpose of carrying the overhead work for the tramways. In addition to these, a further lot of 1,350 poles, thirty-one feet long, were imported. The bracket arm tubes were fitted with scrolls and clamps of pleasing design. The trolley wire, which is of No. 00 B. & S. grooved type, is divided by section insulators into 1,000-metre lengths, for the purpose of isolation in the case of breakdown. The cables which carry the

current to the overhead lines are about twelve miles in length. They are all suspended from toggle insulators on channel iron crossarms, erected on the poles above the spans and brackets. These cables are stranded and are of three sizes, viz., 0.55, 0.45 and 0.33 square inch. They are twin-braided with strong braid, each braid being separately treated with weather-resisting preservative compound.

The power house is a substantial building, steel-framed, with an oval corrugated iron roof. The original building, which was erected some fifteen years ago on the same spot, was built so as to permit of installing additional engines, boilers, etc., when required. The engine room measures eleven metres by fifty metres, the boiler room thirteen by fifty, and the entire building covers 1,200 square metres of ground.

The chimney is of brick construction, forty-five metres high, and with an internal diameter of 3.76 metres. Coal is loaded direct by means of a ten-ton crane from lighters lying alongside in the river into derrick trucks, which are then run and dumped into the boiler house or the coal is stacked in a yard provided for this purpose.

The old equipment consisted of three boilers of the water-tube type, with a heating surface of 242 square metres, and operating at 180 pounds pressure; also one Belleville boiler with economizer and superheater, working at the same pressure. This battery supplies steam to three vertical triple-expansion engines built by the Sachsische Maschinenfabrik Aktiengesellschaft, of Chemnitz, and installed during the years 1894-1896. These engines running at 150 revolutions per minute have each a normal output of 300 horsepower and are direct connected to three Siemens & Halske alternating-current generators of fifty cycles, 2,000 volts, with an output of 240 kilowatts each. Each engine has a direct-connected exciter, giving 120 amperes at 110 volts. There is also one vertical compound Belfort engine of French manufacture, which was installed in 1898. This runs at 150 revolutions per minute, and is direct-connected to a Société Alsacienne single-phase generator, of fifty cycles and 2,000 volts, with a direct-connected exciter, giving 180 amperes at sixty volts. The above plant was used for supplying private and public lighting.

The new equipments supplied by J. G. White & Company consist of four Babcock & Wilcox marine type boilers, each with a heating surface of 2,368 square feet, and a grate area of fifty-six square feet. Each boiler is capable of evaporating 10,000 pounds of water at hot-well temperature into steam at 180 pounds per square inch gauge pressure. Each boiler is fitted with an integral superheater with a heating surface of 440 square feet, capable of raising the temperature of the steam at regular gauge pressure to 500 degrees Fahrenheit.

There are three sets of steam-driven cross-compound air pumps with jet condensers supplied by the Worthington Pump Company. There are two horizontal duplex boiler-feed pumps, each capable of pumping 5,000 gallons of water per hour against a steam pressure of 180 pounds. These were supplied by Hayward, Tyler & Company. There is also one feed-water heater of 100 square feet, capable of raising the temperature of 5,000 gallons of water per hour to seventy-five degrees Fahrenheit, when dealing with 4,000 pounds of exhaust steam per hour. This was supplied by Richardsons, Westgarth & Company. In addition there is one complete purifier and filter plant.

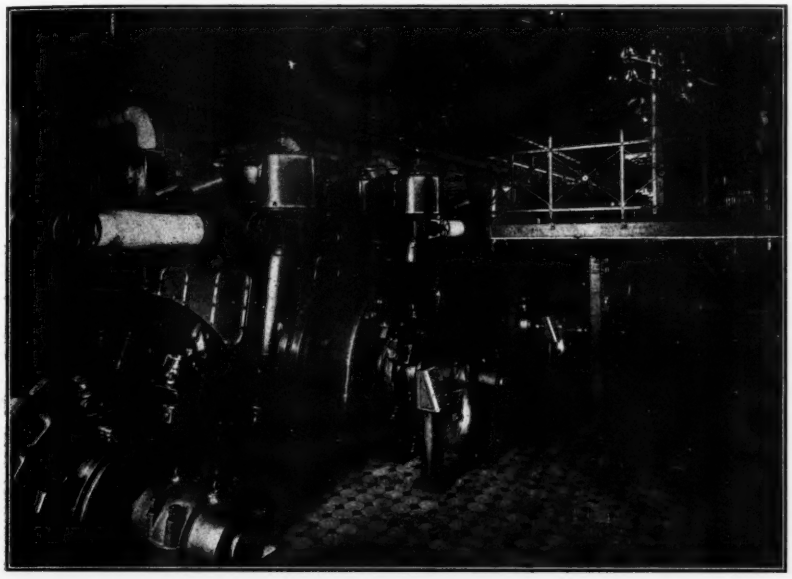
This plant supplies steam to three triple-expansion vertical Belliss & Morcom engines, each of 585 brake horsepower when running at 330 revolutions per minute and capable of carrying twenty-five per cent overload for two hours and fifty per cent overload momentarily. These are direct-connected to three 400-kilowatt compound-wound direct-current generators. There are also two triple-expansion engines of the same type and size, each direct-connected to a single-phase generator of the revolving-field type, working at 2,200 volts and fifty cycles. The regulation of these machines at 0.9 power-factor is eight per cent rise in volts from full load to no load. There is also one forty-brake-horsepower Belliss & Morcom compound engine, running at 625 revolutions per minute, direct-coupled to one twenty-five-kilowatt compound-wound exciter dynamo, giving 200 amperes at 125 volts.

Formerly there was a separately driven steam pump for pumping the water from the river for the boilers and for condensing purposes. In its place has been installed one ten-inch centrifugal pump, direct-coupled to an eighteen-horsepower motor running at 584 revolutions per minute. Water is delivered at the rate of 2,000 gallons per minute to a series of settling tanks made of brick and having a capacity of 1,500 cubic metres. The water being rather muddy, these tanks are cleaned out every six months.

INSIDE A PARA STREET-RAILWAY CAR.

The switchboard gallery is built up of steel framework and stands eight feet above the engine-room floor. The floor of the gallery consists of six inches of concrete, covered with tiles. The switchboard contains all the necessary panels for the railway and lighting loads. The oil switches, isolating switches and lightning arresters, are supported on the underframe of the switchboard gallery. The whole of the switchboard equipment was supplied by Ferranti, Ltd., of London.

The car shed is of the double-end entrance plan and is steel-framed and covered with corrugated iron throughout. The shed is 127 metres long by 37.5 metres wide, and contains ten tracks, six of which have a pit running half the length of the shed. The rails over the pits are supported on iron columns. The floor and pits are concreted and floated over with two inches of cement floating. There are ten tracks running into the shed on the south side and five on the north, so that car movement is facilitated. There is a carpenters' shop, with a capacity for eight cars, and a paint shop for six cars. In addition there are electrical, machine and forge shops, all fitted with the latest tramway and shop tools.



PARA STREET-RAILWAY AND LIGHTING POWER HOUSE.

BOILER HOUSE, PARA STREET RAILWAY AND LIGHTING PLANT.

The cars, which are seventy in number, are of four different types, as follows: (1) Nine combined baggage and second-class vestibule open cars; (2) twenty-four first-class open vestibule cars; (3) twenty-one second-class vestibule open cars; and (4) fourteen first-class double service cars.

In addition to these there are two palace cars, lavishly upholstered and fitted with mahogany tables and swinging arm-chairs. One of these cars is intended for the use of the governor, and the other for the use of the mayor of Para.

The electrical equipments for all the cars were supplied by the General Electric Company, of Schenectady, N. Y. Each car is equipped with two G.E.-67 motors of forty horsepower at 500 volts. The controllers are the B-18 type with one set of handles, magnetic blow-out, circuit-breaker, etc.

Up to the present the high-tension lighting circuits have been all run overhead, the voltage of 2,000 being stepped down to 120 volts by means of transformers fixed on the poles. All the high-tension layout has now been put underground.

The total length of cable laid was approximately fourteen-and-one-half miles. The conductors are of the concentric type. The cables were made for a working pressure of 2,200 volts, and were tested at the makers' works with a pressure of 10,000 volts for thirty minutes between conductors and 2,200 volts for thirty minutes between outer conductor and earth; and when actually laid in Para they withstood all tests satisfactorily. The concentric cables were laid in standard salt-glazed stoneware troughing, with bridge pieces of different sizes to suit the cables. The troughing was filled in with Trinidad bitumen, and the whole covered over with hard glazed stoneware bricks.

There are being installed underground thirty-three cast-iron transformer tanks. They are of varying capacity and are located in suitable positions about the town. The high and low-tension switches are mounted in cast-iron pillars adjoining the pits. Distribution will be on the three-wire system with 240 volts across the outer conductors.

Wood-Preserving Processes in Europe.

An interesting article on processes of wood saving in Europe, especially for preserving railway ties and telegraph poles, appears in Daily Consular Report No. 3466. Copies of this may be had from the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C.

Comparison of Aerial and Underground Wires for Telephony.

Experiments to determine the relative efficiency of aerial and underground lines for telephone purposes have recently been made at Newcastle, England. Speaking from Newcastle to London (nearly 300 miles) was successfully accomplished with the aerial wire, but with the underground cable the voice became almost inaudible at forty-eight miles. For long-distance telephony, then, the aerial wire was proved far superior to the underground cable in this instance. Probably our British cousins never heard of Professor Pupin's researches along this line of work.

THE USE OF LARGE GAS ENGINES FOR GENERATING ELECTRIC POWER.[1]

BY LEONARD ANDREWS AND REGINALD PORTER.

Hitherto the use of large gas engines has been chiefly confined to iron and steel works, where they are run on blast-furnace and other waste gases for driving blowing engines and generating electric power, which is used for rolling mills, etc., in the works, the surplus power being sold, at a very low rate, for municipal lighting and tramway loads, and for industrial works in the neighborhood.

In Germany, the manufacture of large gas engines is an established industry on a large scale. Even in 1906, out of forty-nine smelting works, forty-one had either installed gas engines or had placed orders for them, the engines actually installed at that time aggregating over 295,000 horsepower.

The use of large gas engines for driving electric generators is a subject that is also receiving considerable attention in the United States. The National Electric Light Association has appointed a special committee to report on the use of large gas engines for driving electric generators, and the report was presented to the association at the convention held in Chicago last May. The committee's report,[2] which is very voluminous, concludes with an interesting summary.

While the authors believe that there is an important field for the use of large gas engines for driving electric generators, they do not consider that there is at present justification for the suggestion that has been made, that the internal-combustion engine will, in the early future, be used to the exclusion of the exclusion of the external-combustion engine.

The position, so far as present knowledge goes, may be briefly summarized as follows:

The internal-combustion engine is very much more economical than any external-combustion engine yet known.

The capital cost of a gas engine and producer installation is greater than that of a steam-turbine and boiler installation of equivalent overload capacity.

There is no material difference in the reliability or in the cost of labor, stores and repairs of the respective systems.

In cases, therefore, where the cost of fuel is low, and the load factor is low, it will generally be a mistake to use gas engines. On the other hand, where the load factor is high, or the cost of fuel is high, there can be no doubt that gas engines will prove to be by far the cheapest prime mover to employ for driving electric generators.

The majority of cases to be dealt with will doubtless fall between these two extremes, and engineers responsible for the design of future power houses will have many points to consider before definitely deciding whether the prime movers for the electric generators shall be steam or gas-driven, or a combination of the two.

As the conditions which go to determine whether gas engines should, or should not, be used are in most cases so widely different from the conditions under which experience has, up to the present, been obtained, it is extremely difficult for engineers to utilize the available knowledge upon the subject to the best advantage.

The authors have, therefore, endeavored to collect facts from a large number of different sources, and to apply the information obtained to one or two hypothetical public electric-supply schemes as nearly comparable as possible with many of the existing power supply schemes that are now being carried out in different parts of the country.

COMPARATIVE STEAM-ENGINE AND GAS-ENGINE PLANTS.

For comparative purposes the authors have endeavored to show what, in their opinion, would be the respective total cost of generating power by steam turbines and by gas-driven generators under the assumed conditions specified.

For the first scheme to be considered they have assumed that the estimated maximum load to be dealt with shall be 8,000 kilowatts.

That the overload and standby capacity of the plant shall be such as to carry the maximum load of 8,000 kilowatts for at least two hours, should any portion of the plant break down at the time when one unit is already laid off for overhaul.

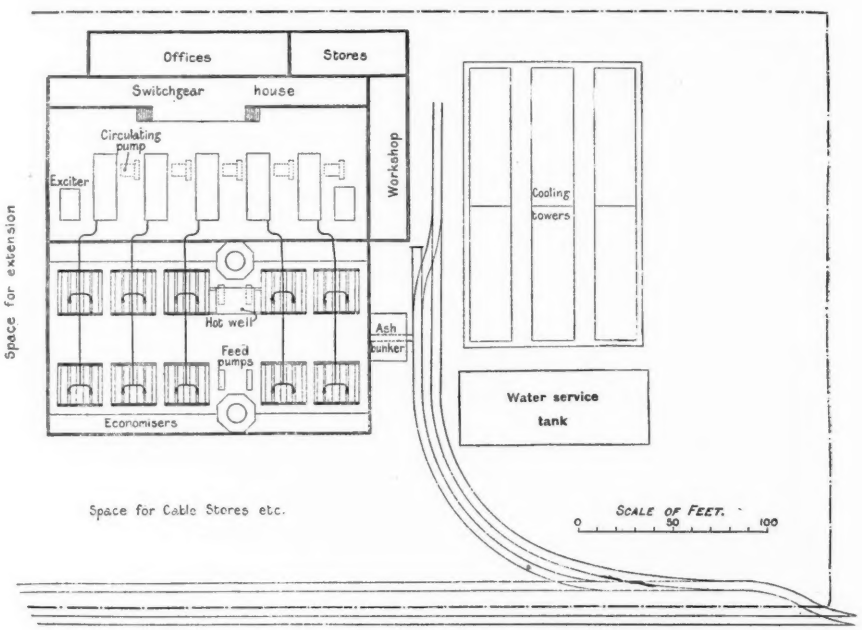


FIG. 1.—PLAN OF 10,000-KILOWATT STEAM-ENGINE PLANT.

That the power generated is utilized for public and private lighting, and for a tramway and general industrial motor load; that the load factor, *i. e.*,

$$\frac{\text{units sold} \times 100}{\text{maximum demand} \times 8{,}760},$$

equals twenty-four per cent, and that the efficiency of distribution—*i. e.*,

$$\frac{\text{units sold} \times 100}{\text{units generated}},$$

equals eighty per cent.

That the cost of good bituminous slack, having a calorific value of 13,000 British thermal units per pound, is $2.92 per ton delivered at the generating station.

The points to be considered in selecting a site for a gas-driven station are practically the same as for a steam-driven station. In choosing a site for a steam-turbine station it is often good policy to

[1] Abstract of a paper read before the Institution of Electrical Engineers at London on February 11, and at Manchester on February 16, 1909.

[2] See WESTERN ELECTRICIAN of May 23, 1908, pages 415 and 421.

sacrifice other advantages in order to get a site with a plentiful supply of cold water for condensing purposes. This advantage has usually, however, to be heavily paid for. As the latitude in the choice of a site is very limited, the cost of land will probably be very much greater. The cost of foundations will also generally be greater, added to which the right of using the water will generally have to be paid for; and, finally, it is more than probable that the site available will not be a good one from the point of view which American engineers term "the electrical center of gravity"—that is to say, the cost of feeders will probably be much greater than if a more central position were selected. It is consequently often very

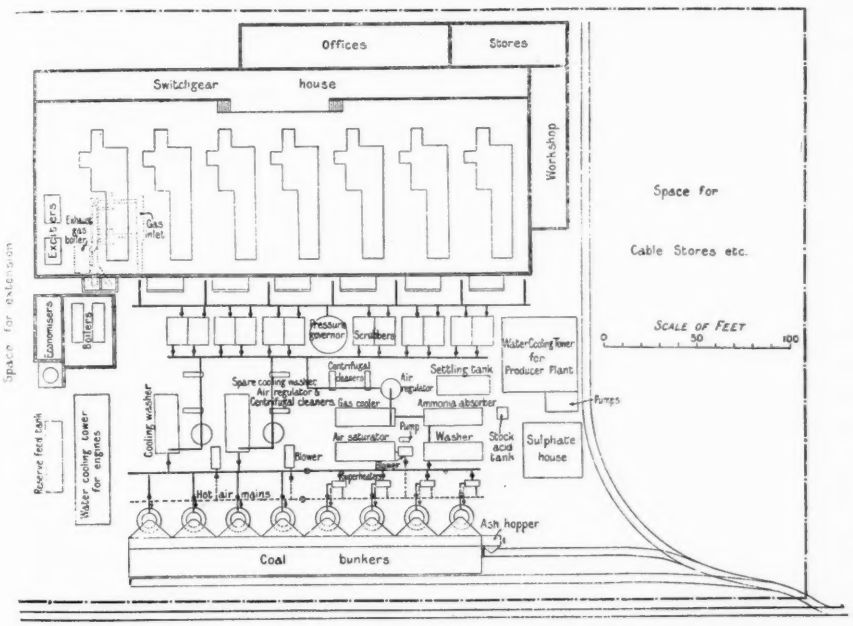


FIG. 2.—PLAN OF 10,000-KILOWATT GAS-ENGINE PLANT.

much cheaper, on the whole, to install cooling towers for condensing purposes. Inasmuch as it is impossible to estimate the cost of obtaining a site with a plentiful water supply, as this will vary largely in every case, the authors have based comparisons upon the assumption that cooling towers will be used in conjunction with a water supply from the public mains.

A convenient layout for the steam plant will be that shown in Fig. 1. Fig. 2 shows a corresponding layout for the gas plant. Either layout provides ample yard-space room for cables, stores, etc., without encroaching on the ground available for future extensions.

For the steam plant they have assumed that steam turbines of the horizontal type would be used directly coupled to three-phase generators—that each turbine would exhaust into a separate contra-flow surface condenser placed directly below the turbines; that the cooling water would be obtained from a town supply and circulated by electrically driven centrifugal pumps through natural-draft cooling towers, a separate pump being installed for each unit. For the gas plant they have assumed that the engines would be of the slow-speed, four-cycle, double-acting tandem type, directly coupled to overhanging flywheel, three-phase generators. The cooling water for the engines would, as in the case of the steam plant, be obtained from a town supply and circulated by means of small piston pumps driven from the engine crankshafts, the water being cooled in natural-draft cooling towers.

Experience has shown that large units in a steam plant are considerably more economical, both in first cost and running cost, than smaller units, and as they can at present be obtained in much larger sizes than gas engines, they have, in some cases, a considerable advantage in this respect. It is possible, for instance, to obtain units of such a size that one plant would be capable with its overload capacity of supplying the specified maximum output of 8,000 kilowatts.

To comply, however, with the suggested specification as to overload capacity, it would be necessary to install two additional units of the same size, with the result that the standby capacity would be altogether out of proportion to the maximum demand, and the first cost would be considerably greater than if smaller units were selected.

For a maximum output of 8,000 kilowatts it appears that the most economical arrangement of units would be five plants, each having a normal capacity of 2,000 kilowatts, with an overload capacity for two hours of thirty-three-and-one-third per cent. In the event of two plants being laid off simultaneously, the remaining three sets would then be capable of supplying the maximum demand for a period of two hours, as specified.

The output of gas-engine units is, at present, limited to about 1,500 horsepower per cylinder. Four such cylinders arranged in twin tandem would give a combined output of 6,000 horsepower, or, say, 4,000 kilowatts.

The arguments against the use of very large steam units for the hypothetical case under consideration also apply to gas-driven units. In fact, for the gas scheme it does not appear to be advisable to use even such large units as 2,000-kilowatt sets, since the overload capacity of gas engines is only ten or twelve per cent, and consequently three 2,000-kilowatt plants would only be able to deal with a maximum demand of 6,600-6,700 kilowatts, and six units of this capacity would therefore be required to deal with the specified maximum demand and provision for standby. A more economical installation would be seven generators, having a normal capacity of 1,450 kilowatts each, and an overload capacity of 1,600 kilowatts. With such an installation, if two generators were laid off simultaneously, the remaining generators would be able to deal with the full maximum demand of 8,000 kilowatts for two hours, as specified.

The next point to be determined is whether the engines should be of the single-tandem or twin-tandem type. The only advantage of the twin-tandem over the single-tandem combination appears to be that, with a four-cycle engine, the crankshaft will receive four impulses per revolution instead of two. It is obvious, therefore, that with a given flywheel effect the cyclic irregularity will be considerably greater with the latter than with the former.

The capital cost of a twin-tandem set is appreciably higher than a single-tandem set of the same output. The cost of fuel, oil and repairs will be slightly higher for the twin-tandem combination, though not appreciably so. The cost of

attendant's wages for the twin-tandem will be practically double that of the single-tandem set, as experience has shown that one attendant is required for each line of engines, whatever the output of the engines. It appears, therefore, that for the conditions under discussion a single-tandem engine is the best type of plant for the purpose.

The authors have assumed that boilers of the water-tube type would be used, fitted with self-contained superheaters and automatic stokers, and that these boilers would be grouped into units corresponding to the output of the turbo-generators, the normal capacity of each battery of boilers being equal to that of the normal output of its turbo-generator. In calculating the boiler capacity it has been assumed that the steam consumption of the turbo-generator under working conditions, including the steam for feed pumps and exciters, would be twenty pounds per kilowatt generated. Therefore four 10,000-pound boilers have been provided for each 2,000-kilowatt turbine. An economizer is provided for each boiler.

From inquiries made both in Germany and the United States, it would appear that large producers for utilizing bituminous coal have not been entirely satisfactory in either of these countries. This is, perhaps, partly accounted for by the fact that the class of coal available in both these countries contains a far greater percentage of ash and is much more liable to clinker than the bituminous coal available here. Whatever the cause may be, the fact remains that there are numbers of bituminous producer installations in this country working entirely satisfactorily in conjunction with large gas engines.

With properly designed engines there appears to be no greater difficulties to contend with than when working on blast-furnace gas. The comparatively high percentage of hydrogen tends to cause pre-ignition if the compression is carried to too high a point. This difficulty is, however, entirely removed by constructing the engines for a lower compression.

Difficulties were experienced in the early days in the removal of tar, dust and other impurities, but the efficient cleaning appliances now included in every properly constructed producer plant appear to have entirely got over these difficulties, or have at least reduced them to such an extent that the small percentage of impurities carried into the engine with the gas have no deleterious effect upon the working of the engine.

Difficulties arising from variations in the quality of the gas caused by charging or clinkring the producers, practically disappear when a number of producers are connected together to feed into a common main or common receiver where the gases from the various producers are mixed together, and the effect of any variation in the quality of the gas from individual producers is thereby neutralized. To derive the full benefit of this feature the producer plant should not be divided into units corresponding to the generator units, as has been recommended for steam boilers.

A very important point to be considered in designing a gas-engine station is that of providing for the recovery of sulphate of ammonia. There are numbers of recovery plants that have been working for some years where the sale of the by-product has almost equaled the cost of the fuel used. Results obtained have been so entirely satisfactory that one is at first sight tempted to think it must pay to provide for sulphate of ammonia recovery in every instance. There are, however, many expenses incidental to the recovery of sulphate of ammonia in addition to the fuel.

Experience, up to the present, appears to indicate that it is not worth while to attempt to recover sulphate of ammonia unless the total output of the plant is greater than 2,000 horsepower, and then only on an exceedingly good load factor.

For a maximum output of 8,000 kilowatts it would probably pay to install an ammonia-recovery plant, even for so poor a load factor as twenty-four per cent. An even more profitable arrangement, however, would be to provide for ammonia recovery on one portion of the plant, which could be kept working at a very high load factor almost continuously, and to use non-recovery plant for dealing with the peak load and remaining portion of the total output.

For the particular conditions now under discussion it is recommended to use eight producers, of which four would be equipped for ammonia recovery and the remaining four for non-recovery.

For both the steam and gas plants, coal bunkers are assumed to be provided capable of carrying a fortnight's consumption of fuel under mean load conditions. In the case of the steam plant, the coal bunkers would be placed over the firing floor of the boilers, and have a capacity under such conditions of approximately 1,500 tons.

In the case of the gas plant, the coal would be stored in bunkers placed on the ground at the back of, and parallel with, the producers. It would be unloaded by hand from the railway trucks on the elevated siding at the back of the bunkers, from which it would gravitate into the coal-conveyor buckets, and be hoisted by these into the hoppers over the producers. These hoppers would be of sufficient capacity to carry twenty-four hours' supply under mean-load conditions. The ashes raked out from below the producers would also be lifted by the same conveyor into the ash hopper provided for the purpose.

The cost of the engine-room and engine foundations for the gas-driven plant is, of course, considerably greater than that of the steam plant, but no building is required for the producers (beyond small boiler and sulphate houses) and the cost of the foundations for the producers is very small, compared with the cost of boiler foundations, flues, chimneys, etc. The total cost of buildings amounts to considerably less, therefore, for the gas station than for the steam station. The estimate of the cost of buildings for the gas-driven plant has been based upon tenders actually received. The price covers a substantial steel-frame building with brick walls, lined internally with a glazed-brick dado six feet high, and with tiled engine-room floor. Included in the estimates are suitable store, workshop, and office accommodation in each case.

It is assumed that for both the steam plant and the gas plant the field circuits of the generators would be excited from bus-bars fed by two steam-driven exciters, each capable of generating the whole of the exciting current required on full load. The exciters would be supplemented by a battery capable of maintaining the full field current required for a period of twenty-four hours.

In the case of the gas plant, the steam for the exciters would be furnished by one of the small coal or tar-fired boilers installed for this purpose. The exhaust steam from the exciter engines would be used in the producers, any additional steam required by the latter being raised by boilers heated by the exhaust gases from the main engines.

The switch gear would be of the remote-control type, the oil-break switches being placed in a switch room running the length of the engine room. The capital cost of the switchgear for the gas

plant will be somewhat higher than for the steam plant, as two additional generator panels and connections will be required.

The total capital cost of the respective steam and gas plants for the specified maximum load of 8,000 kilowatts will, it is estimated, be as follows:

STEAM PLANT.

Five 2,000-kilowatt turbo-generators, erected complete	$197,500
Five surface condensers with air and circulating pumps	49,375
Circulating pipes	6,000
Cooling towers, erected complete	34,500
Twenty water-tube boilers, erected complete with mechanical stokers, economizers, superheaters, feed pumps, water-service tank and feed tank, water-softening plant and all pipe work	156,500
Buildings with engine and boiler foundations, two chimneys and flues	168,000
Overhead traveling crane	5,000
Steel structural work, coal bunkers, coal and ash conveying plant	44,500
Exciters, battery, switchgear and connections to generator	36,250
Total	$697,625

Or $69.76 per kilowatt installed.

GAS PLANT.

Seven 1,450-kilowatt gas engines, generators, air compressors, gas, water, air and exhaust pipes and all auxiliaries, erected complete	$490,000
Four ammonia-recovery producers, erected complete, with superheaters, blowers, cooling and washing towers, centrifugal cleaners, scrubbers, ammonia absorber, and all pipe work	92,450
Duplicate blower, washer and centrifugal cleaners	18,900
Four non-recovery producers with necessary scrubbers, etc	51,700
Steam-raising plant, economizers, feed pumps, etc	24,250
Water-cooling towers, pumps and water softener	9,950
Buildings and foundations, etc	121,375
Overhead traveling crane	6,250
Steel structural work, coal bunkers, coal and ash conveying plant	30,750
Exciters, battery, switchgear and connections to generators	38,750
Total	$884,375

Or $88.44 per kilowatt installed.

RUNNING COSTS.

The fuel consumption of a gas plant, as of a steam plant, is dependent upon at least four important factors:

1. The actual output, which, in an electric generating plant, will be expressed in kilowatt-hours generated.

2. The no-load losses, which include friction, windage and electrical losses incurred in running the generator on open circuit, together with all power required for exciters, pumps, and other auxiliaries.

3. Standby losses of banking boilers or producers.

4. The ratio of the actual ascertained fuel consumption under day-by-day working conditions to the theoretical consumption based upon test results applied to items, 1, 2, and 3, which will be termed the discrepancy factor.

Steam and fuel consumption curves have been plotted from a number of published tests of steam turbines and gas engines of different sizes. The "consumption per unit generated" curve of steam turbines gradually decreases as the output of the plant is increased, whereas the corresponding curve of gas-driven generators is constant for all outputs. Various tests on gas engines of outputs ranging from 500 to 5,000 brake horsepower show that the actual consumption of fuel per unit generated exclusive of no-load losses is approximately one pound per kilowatt-hour for any output from no load to full load.

The losses, through radiation of heat from boilers and steam pipes, and by leakage of cold air through the brickwork of boilers, is a very heavy item in all steam-driven electric generating stations, as the conditions of load are generally such that the majority of the boilers are banked for many hours every day.

As four 10,000-pound boilers are required for each 2,000-kilowatt unit in connection with the steam-turbine station on which the calculations are based, the coal for banking these boilers will be at least 448 pounds per hour per plant unit.

The fuel required for banking producers is only a small fraction of that required for banking boilers. The heat radiation from the producer is also extremely small, because the annular space between the firebrick lining and the outer casing constitutes one of the best non-conductors of heat it is possible to obtain. The standby losses of the producers for the scheme under consideration are guaranteed not to exceed fifty pounds per hour per producer.

It is difficult for those who have not had actual experience in running a generating station to appreciate how impossible it is to keep the discrepancy factor within reasonable limits. This is accounted for by variations in the quality of the fuel supplied, by fuel utilized in heating up cold boilers, by the gradual fouling of boiler tubes, condenser tubes, etc., between cleaning periods, by errors of judgment as to the correct time for running up and shutting down plant units, and other seemingly small details which in a well-managed station receive constant attention, but the effects of which cannot be entirely eliminated.

For both the steam plant and the gas plant, there has, therefore, been added twenty-five per cent to the ascertained fuel consumption under test conditions to cover the above contingencies.

Now, for a maximum demand of 8,000 kilowatts, a load factor of twenty-four per cent and a distribution efficiency of eighty per cent, the units generated per annum will be 21,000,000. The curves in the paper show that for a 2,000-kilowatt turbo-alternator the steam consumption per unit generated is 15.5 pounds, or, assuming an evaporation of eight to one, 1.94 pounds of coal. From the same curves is seen that the no-load losses for a plant of this size amount to 900 pounds per hour.

To determine the plant-unit-hours run, and the boiler-hours banked, curves were plotted to show the average hours the respective plant units would be required each day to deal with the given load curve. It appears that the minimum total engine-hours would be thirty-five hours per day, or 12,800 hours per annum, and the bank-boiler-house would be forty-five hours per day, or 16,800 hours per annum.

The total annual coal consumption for the steam turbines will therefore be as follows:

	Tons.
21,000,000 units at 1.94 lbs.	18,170
21,000,000 units at 1 lb.	9,360
16,800 banked-boiler-hours at 448 lbs.	3,330
	26,640
Discrepancy factor	1.25
Total	33,300

=3.55 lbs. per unit generated.
Overall thermodynamic efficiency=7.4 per cent.

For the gas station the no-load losses of a 1,500-kilowatt gas engine amount to 800 pounds of coal per hour and the useful-output consumption to one pound per unit generated.

A curve was drawn to show the minimum average engine-hours per day for the gas plant and the average hours per day the producers would be banked. It appears from this that the total engine-hours would be 17,450 hours per annum, and banked-producer-hours would be 35,000 hours per annum.

The total coal consumption for the gas plant will therefore be as follows:

	Tons.
12,800 engine-hours at 900 lbs.	5,140
17,450 engine-hours at 800 lbs.	6,230
85,000 banked-producer-hours at 50 lbs.	782
	16,372
Discrepancy factor	1.25
Total	20,465

=2.18 lbs. per unit generated.
Overall thermodynamic efficiency=12 per cent.

It is estimated that approximately seventy-one per cent, or 14,580 tons, of the total coal consumption would be gasified in the ammonia producers and would yield at least 586 tons of sulphate of ammonia. Estimating the value of this at $55 per ton, which is considerably less than its present market value, the sale of this by-product would yield $32,230 per annum.

[To be continued.]

Electrical Notes From Great Britain.

By Our British Correspondent.

About a year ago the Corporation of Greenock, Scotland, put down a refuse destructor plant on the most up-to-date lines, operating in connection with its electricity supply plant. The engineer, J. A. Robertson, has given an interesting account of his practical experience of this combined undertaking since the commencement, and the conclusions to which it has led him, before the Glasgow Local Section of the Institution of Electrical Engineers. He prefaced his notes bearing directly upon that particular plant, by stating the progress made with the combination principle since the first plant was started in 1897 at Shoreditch. It appears that there are now seventy-three such undertakings operating in England, and that these are being added to at the rate of about twenty per annum. There have been some notable failures, but most of the plants mentioned are said to have proved successful, yet the wisdom of the combination still forms a subject of controversy among station engineers. The most important condition required in order that the combination may yield appreciable benefit, is that there must be a fairly steady demand for energy on the electricity works. Generally speaking, it may be laid down that in industrial districts where a power load exists, or where a tramway supply forms part of the station output, financial benefit to the community will follow the combination. Station engineers who object to combined installations chiefly do so because of the presence of dust or fine grit which naturally does not benefit the generating plant if it finds its way to it. The causes of the dust are, the dumping of the refuse in dry weather, the operation of clinkering the fires, and lastly and chiefly, the crushing and screening of clinker. A better arrangement of buildings will obviate the dust nuisance, and in the case of his Greenock plant Mr. Robertson says he has experienced no real trouble from this cause. He has kept accurate records of the working of the plant and he tabulated the results in the course of his statement. Some of the conclusions at which he has arrived may be stated here: Given a suitable design of plant, it is possible to destroy ordinary town's refuse at a combined works without causing nuisance troubles, if the sanitary object of the destructor is considered of primary importance. Where local conditions permit the steam to be utilized for at least nine hours per day, the combination will be a distinct financial advantage. A combined scheme should only be undertaken after careful investigation and under expert advice. In the interests of efficiency the combined installation should be under the control of the electrical engineer.

The London County Council has now definitely decided to take out the G. B. surface contact equipment on the Aldgate-Bow tramway section, and to reconstruct the line partly for working on the overhead-trolley principle, and partly with the underground conduit. The report that was prepared by Mr. W. M. Mordey, the president of the Institution, showed that the contractors had, as ordered, put a mile of stud line into good order, and he was satisfied that he had found a remedy for live studs caused by arcing. Though live studs might still occur the cars themselves would detect them. He advised the overhauling of the rest of the section and its car equipments on the same altered principles. The Council's own chief officer of tramways and its electrical engineer, however, are not satisfied that their former objections to the G. B. system had been removed by what had been effected on the mile, and they recommended abandonment.

The Council has just ordered from Hurst, Nelson & Company mechanically operated auxiliary track brakes for sixty-five electric cars, to cost $13,000. Tenders were invited for three designs of platform gear, namely: "A," with platform gear arranged for screw operation through machine-cut steel pinions, gears and bevel wheels; "B," ditto, "through machine-molded cast-steel pinions," and "C," with the platform gear arranged for operation by means of a spindle and twisted chain instead of the screw operation through pinions, gears and bevel wheels as in "A" and "B." Design "C" has been adopted.

Changes have taken place in the National Electrical Manufacturers' Association. The small membership of the association has, in the eyes of some classes of manufacturers, stamped it as being not representative of the electrical industry. It would not be safe to predict whether the changes will lead to increased membership, though it will be very interesting to watch what their effect is upon the large number of important firms who have so far left the association alone. The secretary, W. Davenport, who has been identified with the organization from the beginning, has resigned, and F. B. O. Hawes has been appointed in his stead. H. Bevis, of the General Electric Company, has been elected chairman of the committee, and the offices have been removed from Westminster, where the Electrical Contractors' Association has occupied the same premises, to the city.

A good deal of discussion is taking place in the city of London at the present moment on the question of establishing industrial banking institutions, perhaps on the same lines as those that are reported to have so signally helped German electrical manufacturers and contractors in securing and financing foreign concessions. The discussion has arisen directly out of the publication of a prospectus in which the Victoria Falls and Transvaal Power Company invited the British investor to find $4,500,000 new capital, the contracts for the work carried out therewith being given to German manufacturers who, in their financial relations with the company, were strongly backed up by the German banks. It is early to say whether the movement will result in a British industrial electrical bank being established, there being so many very doubtful factors in the situation, but the interest of some of the right authorities appears to have been aroused.

The end of the session of the various sections of the Institution of Electrical Engineers is near at hand. At three meetings of the London body the paper by J. H. Rider on the L. C. C. tramways electrical system has received attention. The Manchester Section held its annual general meeting recently, when informal addresses were given on "The Combined Efficiency of Small Gas Engine and Producer Plants," by A. H. Gibson; "The Electrical State of the Upper Atmosphere," by W. Makower, Margaret White and E. Marsden, and "A New Standard of Light," by W. A. Harwood. At Birmingham, the local section has been occupied with "The Manipulation of Telephone Dry-Core Cables," by F. G. C. Baldwin, and "Improvement of Power Factor in Alternating-Current Systems," by M. Walker. Before the Leeds Section the important subject of the electrification of

steam-driven, non-reversing rolling mills has been considered, the author introducing it being W. F. Mylan, who said it was estimated that in Europe there are now upward of 230 electrically-driven, non-reversing mills in operation, the horsepower of the motors used exceeding 200,000. He tabulated a selected list of these, showing that a large number of electrically-driven rolling mills are in commercial operation, giving every satisfaction to the proprietor and justifying their conversion. As a consequence and following on the data obtained from actual installations, the electric driving of rolling mills is now quite past the experimental stage, and it is not only possible to estimate with certainty the size and every feature of an equipment, but to determine very closely the actual cost of operating under any stated conditions. In regard to the effect of having a ready source of power available, it was mentioned that an English mill, taking power at 1.7 cents per kilowatt-hour, effected a saving of over $15,000 on one year's working, more than paying for the cost of the equipment.

At the Royal Institution Alexander Siemens has read a paper on "Tantalum and Its Industrial Applications."

The last two meetings of the Physical Society have been devoted almost entirely to electrical subjects, namely: "Production of Steady Electrical Oscillations in Closed Circuits" and "A Method of Testing Radio-Telegraphic Receivers," by Dr. J. A. Fleming and G. B. Dyke; "Effect of an Air Blast Upon the Spark Discharge of a Condenser Charged by an Induction Coil or Transformer," by Dr. Fleming and H. W. Richardson; "On a Want of Symmetry Shown by Secondary X-Rays," by Professor Bragg and J. L. Glasson; "Transformations of X-Rays," by C. A. Sadler; and "Theory of the Alternate-Current Generator," by Prof. T. R. Lyle. The Iron and Steel Institute holds its annual meetings in London on May 13 and 14; the list of papers announced include several of interest to electrical men, one of them being promised by W. Rodenhauser of Saarbrücken on "The Roechling-Rodenhauser Electric Furnace." The Municipal Electrical Association has issued a preliminary programme of its annual meetings from June 21 to 25. Manchester is to be the center, and the subjects to be discussed are cheap units, metallic filament lamps, steam turbines, cable systems and tramways.

ALBERT H. BRIDGE.

London, April 24, 1909.

New Electric Safety Lamp.

A paper on the new Wolf-Bohres electric safety lamp was read by R. Cremer last month before the North of England Institute of Mining Engineers, which is decidedly illuminative. Mr. Cremer spoke of the two designs of the Wolf-Bohres fitted with an osram lamp made especially for the purpose; one to throw the light downward and the other upward. The osram glow lamp, be it observed, will give an equal light, while using slightly more than half the electrical energy required by a carbon lamp.

The lamp is fixed in a strong, air-tight glass globe, mounted on the top of, or below, the accumulator, and accessible from all sides. The pure air enclosed between the glass globe and the glow lamp and its pressure is thereby increased. Should the glass globe be smashed and the glow lamp injured, then the expanded heated air drives back the outer air of the mine, and will at the same time rush into the vacuum of the lamp. The effect is that the glow lamp is extinguished before an explosive atmosphere has time to enter and to reach the light. The lamp is closed by means of a magnetic hook, preventing unlawful opening or contact sparks.

The single-cell accumulator is enclosed in a celluloid case. The accumulator is connected up to a simple charging device by plugs. The glow lamp is fed by the accumulator and glows for a period of twelve hours per charge, yielding a light of from one to two candlepower.

Magnetic Club's Dinner.

April 21 last was the twenty-first birthday of New York's "Magnetic Club," and in honor of the day a dinner was given at the Hotel St. Denis to about a hundred members and guests. It was a most pleasant affair, winding up with a capital vaudeville entertainment.

One of the special decorations was a huge electric sign bearing the words, "Twenty-one," the coming-of-age day, and underneath this "73," telegraphese for compliments to M. C. The chair was taken by Vice-President Marsden R. Cockey, with George H. Usher, of Atlanta, Ga., a former president, as toastmaster. Speeches were made by Rev. Mr. Foster, pastor of the Marcy Avenue Baptist Church, Brooklyn, Rev. M. K. Bailey of Grace Episcopal Church, New York, and others. Representatives from Boston, Harrisburg and Philadelphia were present. During the evening a telegram was read from President Charles P. Bruch, who is at Atlantic City, recovering from a severe illness.

To Sell Laclede Gas Light Company.

Representatives of the North American Company and of the American Light and Traction Company, it is definitely learned, have under negotiation the sale of the Laclede Gas Light Company of St. Louis, now controlled by the North American Company, to the American Light and Traction Company. The North American Company controls all the street-railway, gas and electric-light companies of St. Louis, and one of the purposes of the deal which is now under consideration, it is said, is to bring to an end the monopoly exercised in St. Louis by the North American Company.

New Exchange for Chicago Telephone Company.

The new exchange building to be built immediately by the Chicago Telephone Company at a cost of nearly $500,000, including $95,000 for the site, will be the largest in the city, and capable of accommodating 40,000 to 50,000 telephones. Its location will be 78-82 Federal Street, formerly Custom House Place. It will be completed within a year.

Wireless Telegraph for Honduras.

James P. Henderson, of Chicago, who is building a railway system throughout Honduras, has just obtained a concession from the government for the installation of a complete wireless-telegraph system in that country. It will connect the north coast and the interior regions through which the railroad passes. There will be four principal stations, at Trujillo, La Ceiba, Puerto Cortes, and Tegucigalpa. The main station will be at the latter city, which is the capital. Mr. Henderson expects to have the system working at an early date.

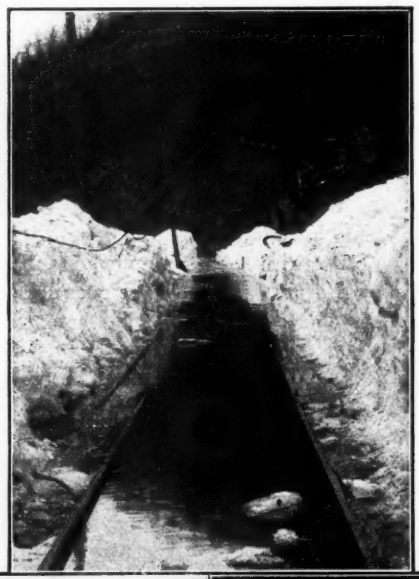
Public Service Commission.

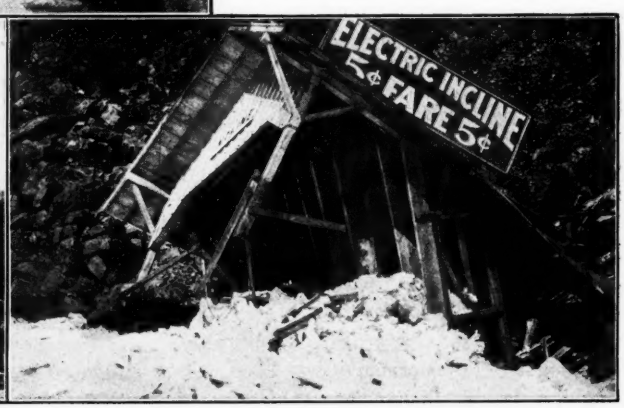
The New York Public Service Commission has adopted a resolution asking the New York Board of Estimate and Apportionment to select a representative from the subway sub-committee to meet a representative of the Public Service Commission and take steps to recommend to their respective bodies a standard form of franchise to be used in future subway construction. The present form was adopted before the passage of the rapid transit act and conditions have shown it has been outgrown.

Restoring the Niagara Gorge Railway.

The last week in April was a busy one with the management of the Niagara Gorge Railroad, a large force of men being kept at work removing the ice and debris from the tracks. The employed forces worked at various points along the line in order that the work of rescuing the scenic line from its unfortunate condition might progress as rapidly as possible. All of the ice had not been cleared at the opening of the present week, but splendid headway had been made.

It has been found that the flood and the accompanying ice was very destructive at some places along the route. A few interesting pictures of scenes are reproduced herewith, and these instructive illustrations tell more than words of the repair work that is yet to be done. It is not yet evident when the road will have recovered from the effects of the greatest ice jam Niagara ever witnessed in recent times. Many poles will have to be reset after a position is found for them, and miles of wire will have to be strung.





THE WORK OF RESTORATION ON THE NIAGARA GORGE RAILWAY.

New Telephone Company for New York City.

A statement has been issued by John M. Shaw concerning the organization of the Public Service Telephone Company, which plans to do business in New York city. Mr. Shaw, according to business reference books, is president, manager and director of the Atlantic Telephone Company. The statement follows:

The organization of the Public Service Telephone Company has been perfected by the election of officers and a board of directors as follows: President, John M. Shaw; directors, George S. Graham, Clarence D. Simpson, R. Conklin, A. G. Wheeler, Jr., and Russell Robbins; secretary, John A. L. Campbell.

The capital stock of the company is $10,000,000, divided into $5,000,000 of preferred and $5,000,000 of common, and it is authorized to issue bonds to the extent of $25,000,000. It is incorporated under section 9 of the transportation act. The purpose of its organization is to do a general telephone business in the city of New York, and with that purpose in view it has taken a lease from the Longacre Electric Light and Power Company for a term of 999 years of a franchise which the Longacre Electric Light and Power Company has to do a telephone business in the city of New York.

This franchise of the Longacre Electric Light and Power Company has been fought out through the courts and finally settled in its favor. The franchise rights leased from the Longacre Electric Light and Power Company are sufficient to enable the Public Service Telephone Company to do business without any additional power conferred upon it by the city. The Public Service Telephone Company is willing to enter into an arrangement with the city by which a reasonable percentage of its receipts shall be paid to the city.

Mackay Companies' Plans.

The Mackay Companies plans for the improvement of its Atlantic cable service are much more comprehensive than has been supposed.

Instead of merely establishing one direct cable route between New York and England via Newfoundland, the Commercial Cable Company will connect two of its present five Atlantic cables with Newfoundland, thus giving to forty per cent of its Atlantic mileage the benefit of a thirty per cent to thirty-five per cent increase in speed transmission, and inaugurating one of the most important improvements in submarine cabling in the last twenty-five years. The expense of routing this second cable will be borne entirely by surplus or current earnings.

When the success of the Newfoundland route is demonstrated, it is probable the company will land other cables there instead of at Nova Scotia as at present.

Another important cable improvement is the automatic relaying device.

Earnings of the Mackay Companies are showing steady gains, and the improvement the last four months has been particularly noticeable.

Pay-As-You-Enter Cars Profitable.

Gross earnings of the Chicago Railways Company in April show a decided increase. The increase is about fifteen-and-one-half per cent over the corresponding month last year. Officials of the company attribute this largely to the introduction of pay-as-you-enter cars, which have also brought larger earnings to the Chicago City Railway Company. The latter now has 513 of these cars in operation and the former runs 430.

LETTERS TO THE EDITOR.

The Cost of Gas and Electric Candlepower.

To THE EDITOR.

Referring to your editorial on page 646 of your issue dated April 10, I note that the basis of your criticism is taken from tests of open-flame burners made by the Public Service Commission, Second District, State of New York. The gas used through these burners represents less than ten per cent of the total output and not more than 215 per cent of the lighting output, and therefore does not represent actual conditions in the industry.

Referring to the sizes of mantle gas burners, there are now on the market an inverted which gives twenty candlepower with a consumption of one foot an hour and an upright which consumes about fifty per cent more gas with nearly fifty candlepower.

In making comparisons with electric-lighting costs your position is evidently that incandescent lamps operate under laboratory efficiencies while in service, but improper voltage regulation and poor sorting makes the situation at least comparable with gas-burner operation.

Whether or not this is the case, no good can accrue the lighting industry, either electric or gas, by mudslinging. At the last meeting of the New York Section of the Illuminating Engineering Society, which is largely composed of those connected with the electric industry, one of their champions questioned certain statements as to relative costs along the same lines as your editorial, with the result that the discussion might have been justly labeled "What I know about poor service, both gas and electric," and would have done credit to a taxpayers' alliance.

The margin of cost between gas and electric lighting is still sufficiently wide to cause those connected with the former industry no uneasiness, and undoubtedly the latter illuminant has some advantages or it would not be supplied by over 5,000 central stations in this country alone. "People who live in glass houses," etc.

SPECTATOR.

New York, April 24.

"Increasing the Popularity of Electric Vehicles."

To THE EDITOR:

It appears to me that in his article on "Increasing the Popularity of Electric Vehicles" in your issue of April 10, Mr. Frank B. Rae generalizes for the entire country on local data. While it is probably true that the service current of garages in Chicago may generally be about 115 volts direct current, the current of the vast majority of cities throughout the United States is alternating. And this is particularly true of cities in which the electric vehicle has made the greatest headway.

Thorough consideration of the ampere-hour output per pound of battery shows that this approaches its maximum as the plates become larger, and the structural parts and containing vessels must be reduced to the minimum per unit area of the active material. By this the lowest possible number of cells is clearly indicated.

Furthermore, it has been abundantly demonstrated that it is more economical to charge vehicle batteries from alternating service by means of rectifying devices than by charging from direct current. There is a reason for this, aside from the fact that the rectifier has a notably high efficiency for a small unit. This reason lies in the fact that with alternating service the current may be regulated by reactance, which is inherently a method of perfect efficiency, as compared with resistance as necessarily used for regulation of direct current.

The most important proposition in the engineering principles involved in the design of electric vehicles is that the battery weight should not exceed twenty-five to thirty per cent of the vehicle. When this is exceeded the excess battery weight is expended in carrying itself about.

These considerations, it appears to me, should lead to the adoption of a minimum number of cells—say, twenty—for electric vehicles.

C. W. SIRCH.

Storage Battery Cars for Prussian Railways.

Consul Southard P. Warner, of Leipzig, advises that the Prussian railway authorities have ordered fifty-seven new accumulator double cars for use in those sections of the country where the passenger traffic is so light that it would not pay to operate regular trains drawn by steam locomotives.

These double cars are composed of two nearly identical sections coupled very closely together. It was found to be impracticable to have single coaches, as in order to have the desired seating capacity they would have to be constructed of such length as to render them unsuitable for use on tracks containing anything more than very moderate curves.

The cars differ from ordinary cars in that they have a tank constructed at either end. These tanks, which are only slightly more than half as high as the remainder of the coach, contain the storage batteries. The batteries are composed of 168 cells, half of which are located in the front tank and half in the rear tank. As the tanks are isolated from the passenger compartments, travelers will never be annoyed by the acid fumes.

The electrical equipment of these cars consists of two eighty-horsepower motors. The battery has a tension of 310 volts and a capacity of 368 ampere-hours. The cars weigh about fifty-five long tons and can attain a maximum speed of thirty-one miles an hour. They will have a seating capacity of about 100, besides an extra compartment for the train crew. Upon one charge of the battery they can run about sixty-five miles. As they can run by using only half the battery (eighty-four cells), traffic would not be interrupted in case one half or the other half should get out of order.

In addition to the air brakes the cars will be equipped with electrical brakes and also with emergency hand brakes. During the trials it was found that a car traveling at a rate of thirty-six miles an hour it could be brought to a standstill within a distance of 220 yards by applying the air brakes. When the air and electrical brakes were applied simultaneously, the car was brought to a stop in 110 yards. In case the two sections of a car should be separated, air brakes would be applied automatically on each section. The compressed air for operating the brakes is supplied by a compressor driven by a two-and-one-half-horsepower motor. By an automatic equipment the compressor is set in motion by the motor as soon as the air pressure drops below a certain point, and is stopped again as the pressure rises.

Signals will be given by means of an electrically operated horn instead of with a whistle. All of the signal lanterns will be equipped with two electric lamps supplied by two independent currents, so that in case one wire becomes disabled the other may be used immediately.

For a Pilgrim Tercentennial Exposition.

The Boston *Herald* announces that in 1920 a world's exposition will be held in Boston, celebrating the 300th anniversary of the landing of the Pilgrims and the founding of New England. Steps are being taken to establish a permanent organization.

The National Association of Cotton Manufacturers.

The annual meeting of the National Association of Cotton Manufacturers was held in the Mechanics' Fair Building, Boston, Mass., April 28 and 29. The report of the secretary, Dr. C. J. H. Woodbury, reviewed the extensive work which was carried on by the committees of the association. Among the interesting papers taken up were the following:

"Improvements in Lighting Large Textile Areas with High Efficiency Units," by A. Thatcher Holbrook, Boston, Mass.

Mr. Holbrook said that as the mills have increased in production the tendency has been greater and greater to outgrow the cramped and narrow quarters of early mills, and it was the purpose of the paper to show that these large areas could be lighted with satisfaction and with reasonable expense. Mr. Holbrook reviewed the development of the electric-lighting industry and described the various forms of arc and incandescent lamps. He endorsed particularly the Nernst lamp.

"Transportation for Mill Yards," by Day Baker, Boston, Mass.

Mr. Baker summarized the necessities of yard transportation for mills in general and led up to the conclusion that for all purposes the electric truck tended to marked economy when used as a substitute for horse-drawn or other vehicles.

The following statement and estimate were made for one of the most conservative mill operators in New England:

Teaming:		
Total cost for five years ending Dec. 29, 1907 (not including hired teams for mill coal)	$33,419	
Of which, the labor of drivers and helpers	24,961	
Leaving as cost of grain, shoeing, harness repairs, horse renewals		$ 8,457
As this is for ten horses for five years, the cost per horse per year		169
Electric Trucks:		
It is contended that a two-ton electric truck can do 30 miles per day on a single battery charge, and that it can easily do the work now done by two double teams. One builder claims more than this.		
Cost complete, including battery, etc.		3,400
Estimated cost of charging equipment, to charge three trucks		250
Spare parts, in case of accident		350
Amount invested in electric truck, etc.		$ 4,000
For comparison with horses, deduct estimated value of four horses, carts		1,000
Excess amount invested, say		$ 3,000
Expenses of Truck:		
Interest on investment, 6 per cent		180
Depreciation, 10 per cent (batteries and tires below)		310
Batteries, $207; tires, $235 (each said to run one year)		442
Two men to operate truck, one at $1.75, one at $1.25		900
Cost to operate truck one year		$ 1,832
On the basis of last five years cost of teaming, the displacing of four horses, four men on two double teams, would be:		
Four horses at $169.17 a horse		676
Four men at same rates as above		1,800
		$2,476
		1,832
Saving by the use of one truck		$ 644

If more than one truck is used the saving would be more in proportion.

As a result of the investigation, two General Vehicle Company motor trucks were installed. The mill teaming account was $6,800 a year, or $569 a month, but by the additions of the first two machines a saving of $266 a month, or $3,200 a year, has been shown. Of course, this high rate can hardly be maintained, but a handsome saving can and will be shown in the following years, which will make the truck investment one of the most profitable.

In one of the largest mill corporation plants in the United States, four motor vehicle trucks have been installed, displacing about thirty horses and the many wagons and trucks which it was necessary to use.

In another cotton manufacturing industry a five-ton electric vehicle was installed, working ten hours a day, taking the place of three horse-drawn trucks. Later, the enterprising engineer of this mill proposed purchasing an extra battery, putting on a night crew and operating the truck twenty working hours per day. This has been done, and as a result the entire stable has been dispensed with, and the machine truck is now doing the work which before required seven horse-drawn trucks.

"The Care of Commutators," by T. E. Chappel, New York city, was taken up at the second day's session.

The election of officers resulted as follows: President, Charles T. Plunkett, Adams, Mass.; vice-presidents, G. Otis Draper, New York, N. Y.; Franklin W. Hobbs, Boston, Mass. Directors for three years, George P. Grant, Jr., Fitchburg, Mass.; Edwin Farnham Greene, Boston, Mass., and David S. Johnston, Cohoes, N. Y. C. J. H. Woodbury was re-elected secretary and treasurer.

Scranton Electrical Men Enjoy a Banquet.

The Scranton (Pa.) Electric Company tendered a banquet on Wednesday, April 21, to the electrical contractors and wiremen of the city. The company was represented by D. T. Campbell. Among the guests of honor were Geo. Wiederman, James R. Strong, M. J. Maroney of New York city, and a number of other out-of-town visitors. The banquet followed the first meeting of the electrical contractors of the city, who discussed the feasibility of establishing an organization which will eventually become a part of the National Electrical Contractors' Association. The meeting was addressed by Mr. Strong, who is a past-president of the National association. Among others present were the following: Chas. M. Barnes, W. S. Maddock, W. J. Neave, C. S. Nicol, G. F. Smith, H. F. Hartman, William A. Timlin, George B. Timlin, Thomas F. O'Hara, Duncan T. Campbell, J. H. Docking, W. A. Hutton, Ely Harris, J. G. Osterhout, E. A. Cameron, W. P. Gallagher, Thomas C. Walsh, Tom F. Roche, Chas. J. McHugh, F. D. Collins, T. F. Eynon, Geo. Pugh Smith, Alexander S. Thompson, W. J. Meyers, J. Bruce Kilmore, J. B. Ratchford, James Morris, F. H. Eisele, Fred R. Smith, James A. Fleming, M. L. Lining of the Scranton Electric Company, Frank Howard of the Scranton Electric Company, H. T. Evans, E. A. Howley, F. S. Smith, Louis Savadkin, John B. Page, John F. Boyle, Ezra R. Fern, F. P. Groves, Howard Groves, Jos. B. Voros, W. A. Harvey, P. F. Duffy, W. H. Fries, A. E. Rittenhouse, John J. Jordan, James R. Strong, L. H. Conklin, George Weiderman, M. J. Maroney, J. E. Kern, J. U. Hopewell and Saul Rubinow.

To Save Power Sites.

Secretary Bellinger of the Interior Department at Washington has instructed the director of the Geological Survey to investigate power sites under the public domain outside of national forests, which are not included in withdrawals for reclamation purposes, with a view to securing at the next session of Congress legislation to control and regulate their disposition.

The secretary said the purpose of this order was to conserve and secure the proper development of the waterpower resources of the public domain through appropriate legislation. The statement was made also that the secretary was extremely anxious to prevent these natural resources from passing under the control of monopolistic or speculative interests.

American Institute of Electrical Engineers' Annual Meeting.

The American Institute of Electrical Engineers will hold its annual meeting in New York city on Tuesday, May 18. The usual reports will be presented—fiscal and standing committees, and the result of the voting for officers for the year will then be made known. Besides the routine business mentioned, Frederick P. Fish, former president of the American Telephone and Telegraph Company, will present a paper on the "Patent System in Its Relation to Industrial Development."

Ithaca Section of the American Institute of Electrical Engineers.

The April meeting of the Ithaca Section, American Institute of Electrical Engineers was held Friday evening, April 23, in Sibley Auditorium, Cornell University. The meeting was attended by nearly 400 members of the local section and their friends. Prof. Frederick Bedell presided over the meeting, which was addressed by Frank J. Sprague of New York city, on the subject, "The Electrification of Steam Railways." A great deal of interest was displayed in the subject, and the discussion after the regular address prolonged the meeting to a late hour.

Mr. Sprague briefly sketched the growth of the electric-railway industry and discussed the problems to be solved by the steam-railway engineer when confronted by the necessity of increasing the capacity of his road to accommodate increase in business. Taking up the various systems of electric-railway operation, he showed the defects or advantages of each.

The subject of electrification was treated by Mr. Sprague in the following order:

(a) A comparison of power transmission and distribution in polyphase, single-phase and direct-current systems.

(b) The characteristics of the motors used in the several systems.

(c) Motor and train schedules.

(d) Electric braking.

(e) Considerations affecting the choice of a system.

(f) Circumstances justifying the electrification of a road.

(g) Comparison of direct-current and single-phase alternating-current equipments. Under this head he showed that the single-phase system had in some instances proven a disappointment on account of the lack of overload capacity of this type of motor and its sensitiveness to overloads.

He showed that for single-phase and direct-current systems, cars of the same carrying capacity, operating at practically identical schedules, the cost of power at the generating station was the same. The weight of the single-phase equipment was shown to be greater than the direct-current equipment for the same capacity. Due to this greater weight of the alternating-current apparatus the initial cost of motors and of car bodies and tracks is greater for the alternating-current system. In summing up his comparison of the two systems, he declared that the direct-current system is preferable for the usual interurban or trunk-line railway for the following reasons:

1. Same or lower first cost.
2. Greater reliability.
3. Larger reserve capacity.
4. Lower total maintenance cost.
5. With increased frequency of stops, a higher speed schedule.

The Electrical Engineering Society of Columbia University.

The last meeting of the present season of the Electrical Engineering Society of Columbia University was held on the evening of April 30, the speaker being Percy H. Thomas, whose subject was "Lightning Arresters."

As might be expected the introduction proved to be the most important portion of the talk, as so many conflicting theories have been advanced regarding the phenomena of lightning, and many of them were briefly sketched.

Referring to troubles on transmission lines, the speaker called attention to the two most important features, namely, the damage done by the current from the generator unless the arc could be broken, and further the well-nigh insurmountable difficulty of placing the arresters where the current would be led to them instead of jumping through insulators and poles. In regard to damage to machinery Mr. Thomas stated that owing to the introduction of the newer type of generators the dangers were to a great extent overcome.

The various types of arresters were then taken up, and the good and bad features of choke coils, multi-gap and electrolytic cell arresters were discussed.

It is to be hoped that when the fall meetings are inaugurated that much more publicity will be given them, for undoubtedly the attendance of visitors would enhance their value. In many respects they are of much greater import than those given under the auspices of other bodies and deserve more attention than they have received in the past.

The American Street and Interurban Railway Association.

The American Street and Interurban Railway Association and affiliated associations will hold their annual conventions at Denver, Colo., Monday, Tuesday, Wednesday, Thursday and Friday, October 18 to 22.

Exhibit spaces will be provided in the new Denver Auditorium and adjacent space.

The Pinch Interrupter.

At the recent meeting of the Armour Institute of Technology Branch of the American Institute of Electrical Engineers, Prof. G. E. Marsh delivered a paper dealing with theoretical and experimental features of the so-called electrolytic type of interrupter known by the name of Caldwell or Simon. Inasmuch as the "pinch" effect, discovered by Carl Hemig and studied by Northrup a couple of years ago, is the active phenomenon underlying the operation of this interrupter, it was spoken of by the above title.

By means of curves and equations the laws governing the pinch phenomenon were clearly indicated and its characteristics were exhibited in a striking manner.

An interrupter of original design was shown in operation, and its performance easily confirmed the statements of Mr. Marsh that for negligible cost of maintenance, durability and constancy of operation, the present form must be considered superior to other types capable of being operated from lighting circuits.

Navy to Try Out Wireless.

No action will be taken by the Navy Department in awarding contracts for construction and equipment of the wireless telegraph tower at or near Washington until the company seeking the contracts has demonstrated to the satisfaction of the department its ability to fulfill the requirements.

A series of tests lasting probably three months will take place at the company's station at Brant Rock, Mass. Lieutenant George C. Sweet will probably be the officer detailed to witness these tests.

Wants Tunnel Limits Decided.

Frank Hedley, manager for the trustees of the New York & Long Island Railroad Company, which owns the Belmont Tunnel, has sent a letter to William G. McAdoo, president of the Hudson & Manhattan Railroad, relative to the terms of the certificate which the latter company has applied for from the Public Service Commission for the proposed extension of the Sixth Avenue subway to the Grand Central Station, New York city.

Mr. Hedley asks that the terms of the certificate shall be phrased so as to definitely exclude the McAdoo Tunnel Company from building north of the center line of Forty-second Street, east of Vanderbilt Avenue. The object of this is to prevent any interference with any future extensions of the Belmont Tunnel.

Boston Edison Purchases Local Concerns.

At a stockholders' meeting of the Edison Electric Illuminating Company of Boston the stockholders voted to purchase the locations and the property of the Chelsea Gas Light Company, the Boston Consolidated Gas Company, the Newton and Watertown Gas Light Company, the Waltham Gas Light Company and the Lexington Gas and Electric Light Company.

President Edgar stated that it was not the intention of the directors to issue any additional Edison stock to pay for the properties for probably a year, as the company has about $2,000,000 cash on hand with the final payment on May 3 on the last issue of new stock offered to stockholders last winter.

The prices to be paid the several companies for their electric business are as follows:

Companies.	Price.
Boston Consolidated Gas Company	$1,300,000
Chelsea Gas Company	350,000
Newton & Watertown Gas Company	500,000
Waltham Gas Company	600,000
Lexington Gas and Electric Company	120,000
Total	$2,870,000

Beginning on Monday last, the Edison Company of Boston is supplying power to the street-railway lines of the Boston Suburban Electric Companies under the ten-year contract recently made in connection with the transfer of the electric plant of the Waltham Gas and Electric Company to the Edison Company for $600,000. The present supply will be about 700 horsepower per annum.

The price of $2,870,000 to be paid the five gas companies for their electric plants does not represent the net cost to the Edison company, as it in turn will sell the gas business of the Newton and Watertown Gas Light Company to the Massachusetts Gas Companies. In addition the Edison company owns $175,000 first-mortgage bonds of the Chelsea Gas Light Company and other securities which are to be retired as the result of the present transfers of property.

Incorporates to Build Subway.

The incorporation of the Tri-Borough Railroad Company at Albany, N. Y., it is stated, paves the way for the Bradley-Gaffney-Steers combination of prospective subway constructors to build and operate the Fourth Avenue (Brooklyn) subway route in conjunction with the Broadway-Lexington Avenue (Manhattan) route, concerning which the syndicate has already approached the Public Service Commission. There will be a connection over the Manhattan Bridge, according to the plans of the syndicate, and a direct line to Canal Street, where it was proposed that the Broadway-Lexington Avenue line should connect with the loop of city-built subway which is to join the Brooklyn, Manhattan and Williamsburg bridges.

It appears that the new law relating to the construction of subways by private capital under the indeterminate-franchise and profit-sharing plan is satisfactory to the Bradley-Gaffney-Steers combination, and that these interests are ready to bid under the law as it stands. It was decided, however, in recent conferences that the original proposition of constructing subways as an engineering proposition would not be the most advisable for the comprehensive plan of subway building in the three boroughs of Manhattan, the Bronx and Brooklyn. Accordingly, the railroad company has been incorporated.

A proposition will be submitted simultaneously to the Board of Estimate and the Public Service Commission for the first link in the Tri-Borough line, namely, a subway in Canal Street in Manhattan, thence over the Manhattan Bridge, and from the bridge by subway out as far as Flatbush Avenue, on the Fourth Avenue (Brooklyn) route. The company as at present incorporated is formed specifically for the construction of this line, but it is understood that the other bids will follow.

It is proposed to carry passengers from Canal Street in Manhattan to Flatbush Avenue in Brooklyn for a three-cent fare. While the arrangements as to the fare over the entire system are not stated, it is probable that a five-cent fare will cover the entire trip from the Bronx terminus out to Flatbush Avenue, as in the case of the Interborough subway.

Graduate Study at the Massachusetts Institute of Technology.

In the recent report of Acting-President Arthur A. Noyes of the Massachusetts Institute of Technology particular emphasis is placed on the advanced instruction of graduate students. Dr. Noyes points to the fuller provision now made at the Institute for advanced study leading to the higher degrees of master of science, doctor of philosophy, and doctor of engineering as one of the most important developments of the year.

Another important movement which also supports the cause of advanced study at the Institute of Technology, has been the establishment of the new research laboratory of applied chemistry in which opportunities are afforded for research assistants and advanced students to execute investigations of chemical problems which are of interest to manufacturers. This research laboratory co-operates with the research laboratory of physical chemistry which has been supported by the Institute of Technology for some years. It is hoped that a research laboratory of applied electricity may soon be established.

During the present Institute year graduate students received the advantages of $5,100 in awards for fellowships and graduate scholarships. Another factor of importance for graduate students is the library; and the value which is attached to it at the Institute of Technology is indicated by the fact that the accessions to the library aggregated 4,563 items for the year 1908.

The students now at the Institute of Technology who are graduates of the courses of this or other institutions aggregate 215, and these come from ninety-one different colleges and universities. The largest number from any one institution besides the Institute of Technology is sixteen. Many of these students are taking undergraduate engineering work in the Institute classes. Others are pursuing the advanced or graduate instruction.

Among the total student body, forty-six states and territories, besides the District of Columbia, the Philippine Islands, Porto Rico, and the Canal Zone are represented, and thirty foreign countries are also represented.

Patent Records Again Broken.

Two weeks ago note was made in these columns of the exceptionally large number of patents issued at Washington on April 6. The issues of April 20 and 27 exceeded these totals. The April 27 issue aggregated 805 patents, one less than the preceding week. Of these 805 patents, 125 were electrical, and of these forty-seven were assigned to the General Electric Company.

The Detroit United Railway.

In a report recently issued by the Michigan Railroad Commission it is stated that the net income for the past year of the Detroit United Railway was $1,027,604.28, about as much as all of the other electric companies in the state combined. The Detroit United Railway had 368.04 miles of road. There were 1,061.54 miles of electric road in the state.

High-Speed Submarine Telegraphy.

In a recent address before the Royal Institution in London on the subject of "Modern Submarine Telegraphy," Sidney G. Brown traced the development of communication by cable and how it may be improved in both speed and reliability. He described in general the construction of the modern cables and various methods of operating them. The great obstacles to speed in signaling are the capacity and resistance of the cable.

The current usually received at the end of a submarine cable would be 1,000 times greater if we had only to deal with resistance without considering capacity. For a certain size of gutta-percha core the use of a large copper conductor decreases the resistance and increases the capacity. There is, however, a critical point at which the product of capacity and resistance is a minimum, and this is when the ratio of the diameter of the wire to the diameter of the gutta-percha core is as 1 to 1.65. Mr. Brown considered that some cable difficulties could be overcome by greater care in the process of manufacture, or by the substitution for gutta-percha of dry cotton or similar material, well impregnated with gutta-percha compound. He suggested the following proportions for an ideal core as compared with the Atlantic cable of 1894:

	1894 Cable.	Ideal Core.
Diameter of core.....	.466 in.	.466 in.
Diameter of copper.....	.202 in.	.282 in.
Resistance per nautical mile .....1.684 ohms.		0.864 ohm.
Capacity per nautical mile .....0.420 microfarad		0.700 microfarad

The speed of working such an ideal cable on the duplex system would be about 240 letters per minute, and the current received with this speed would be twice as great as in the actual cable. A still greater speed than that given might result, possibly reaching to 260 letters per minute.

With the alphabetical code used in the submarine service, the signals which are sent through a cable are of varying lengths, the longest impulse being five times that of the shortest signal. The slower signals go through the cable with more vigor than is necessary, and are consequently distorted. This led to several attempts to retard the slower signals, commencing with the system of Varley, who in 1862 inserted condensers in series with the conductor at each end of the cable. The lecturer dealt with various difficulties due to the employment of condensers, and described in detail the duplex method, wherein an artificial cable is used in conjunction with the real cable, the signals being sent and received simultaneously from either end in the same manner as the duplex system used on land wires, except that there is a greater necessity for a perfect balance between the real and the artificial cable. The electrical properties of the artificial cable must not vary by more than one-eight-thousandth of those of the actual cable, but with the author's high-speed system the balance has to be maintained to within the proportion of 72,000 to one.

Mr. Brown described the siphon recorder invented by Lord Kelvin in 1867 and contrasted it with his own new drum cable relay. Efforts to turn the siphon recorder into a relay had failed for various reasons. The drum-relay apparatus is similar to the siphon in so far as the suspended coil and connected fibers are concerned, but there is a relay contact arm in place of the inking siphon, and the end of this arm is arranged to press upon the surface of a revolving drum instead of upon a paper ribbon. The outer drum surface, which is of gold or silver, is divided into three parts—a central insulated portion, upon which the end of the contact arm normally rests when no signals are received, and the portions on each side, which are included in the circuit of a local battery and two Post Office pattern relays. When a signal is received the arm slides into contact with one or other of the outer portions of the drum, closes a local battery circuit, and thus operates the relay system. The fact that the drum is turning while the arm slides upon it, materially reduces the friction at the point of contact.

During the last year the Eastern Telegraph Company had lent Mr. Brown its lines for a trial of his system of working. The cable over which the tests took place stretches from Porthcurnow in Cornwall to Gibraltar, and is normally worked at 170 letters per minute, each way, with the siphon recorder as receiver. With the new method, using a special relay, duplex traffic has been carried continuously at from 230 to 240 letters per minute. On special trial runs, not carrying traffic, and not sending into the cable at the receiving station, although on duplex conditions, a speed of 280 letters per minute has been obtained. When a submarine cable is forced much beyond its normal speed of working the quickly changing signals, such as make up the letter C, are the first to fail, or, in other words, do not arrive with sufficient strength to work the receiver. It was found with the high-speed system that on allowing more of the current from the cable to flow through the receiver, by increasing, for instance, the size of the receiving condenser, the first and last signal of a series of reversals could be obtained with sufficient strength to work the relay efficiently. The drum relay, once started, is arranged to bring in fresh energy from its local battery through a special retarding circuit to add to the strength of the quickly changing currents on its own coil, and thus the reversals are made strong enough to produce a record, which without this aid they would have been unable to do. By these means weak signals are built up at the receiving end of the cable, and the speed of working can be materially increased. It was fortunate that the class of signal that has the greatest difficulty in getting through the cable is the easiest to be added to when received. The high-speed relay works, therefore, not from the signals received from the cable only, but also from those that it transmits through its own local circuit, the record that it makes being the combined action of the two.

The National Ecuadorian Exposition.

Sam Houston Carr, who has recently been a United States government representative in Cuba, has arranged to act as a representative of American firms who wish to make exhibits at the National Ecuadorian Exposition in Quito from August 10 to October 10, 1910. All exhibits are admitted into Ecuador free of duty and the steamship lines have offered to carry return exhibits back to New York free of charge. Interested concerns should address Mr. Carr at 1841 U Street, Washington, D. C.

Subway Debt Limit Bill Passes New York State Assembly.

The New York State Assembly has passed by a vote of 126 to 13 the Travis-Lee constitutional amendment resolution to furnish additional funds for subways construction in New York city by exempting revenue-producing bonds from the computation of the city's debt limit.

Japanese Electric Consolidation.

Advices from Tokio announce the amalgamation of the American General Electric Company, the Shibaura Engineering Works, and the Tokio Electric Company. The American General Electric Company is a big shareholder of the Tokio Electric Company, which is now principally manufacturing electric lamps.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A NEW ELECTRIC HARDENING FURNACE.

A paper by E. Sabersky and E. Adler on "A New Electrical Hardening Furnace," was read by Mr. Adler at a recent meeting of the Faraday Society. The reading of the paper was illustrated by lantern slides. The authors described a new electrical hardening furnace built by the Allgemeine Elektricitäts-Gesellschaft, Berlin, and consisting of a fireclay crucible containing a bath of metallic salts. By means of the electric current these salts are melted and kept at a temperature which can be made to reach any value up to, say 1,400 degrees centigrade. For working this furnace alternating current of a voltage not exceeding seventy is used, and by means of a transformer fitted with regulator and switchboard, the supply voltage is lowered to this value. The authors also explicitly described the method of operating the furnace and of measuring its temperature. They also further set forth the general principles underlying the hardening process, and used for demonstrating these the diagram of solidification points originally developed by Sir William Roberts Austen. They showed that hardening means, essentially, the fixation of the "martensitic" state of the steel. The hardening process consists of: (*a*) Heating up of the steel to a temperature above the transition line; (*b*) a subsequent rapid cooling down. The authors gave a list of propositions covering the features an ideal furnace should possess, and tried to show that the new electrical furnace fulfills these conditions to a greater extent than any furnace on the market. They also claim that the operating cost of the new electrical furnace on the basis of equal output works out lower than that of gas-fired muffle or bath furnaces.—*Abstracted from The Mechanical Engineer (Manchester, Eng.), April 16.*

ANOTHER SOLUTION OF THE WIRING PROBLEM.

At present it may be said that there are two distinct methods of wiring houses at a reasonably low cost. One is to give the cable a metallic covering of sufficient strength to afford mechanical protection, while at the same time permitting a reasonable amount of flexibility. Such a system presents a satisfactory solution and one that can be applied not only to surface work but also to work that is concealed beneath the plaster. The second method deals with surface work only. It has been pointed out that although so-called "flexible" may not be so suitable for this purpose in England as in some other countries, a special kind of cable might very well be evolved for the purpose. A flexible twin wire has recently been produced which is now available for surface work. This is made in three grades. The first is armored with tinned-iron wire, the second is covered with flameproof material over a weatherproof covering, and the third is simply covered with cotton also over a weatherproof covering. The only accessory required with this system of wiring is a standard circular iron box which is so constructed that it will take a ceiling rose, a switch or a wall plug. The box may also be employed as an ordinary junction box. The internal dimensions of the box are two and three-eighths inches by one inch, and ample room is allowed for making the connections. The box is fitted with a porcelain interior on which terminals are placed for connecting with the various circuits. For fixing wires to the face of a wall a small brass clip is used resembling a clip for a bicycle pump.—*Abstracted from The Electrician (London), April 23.*

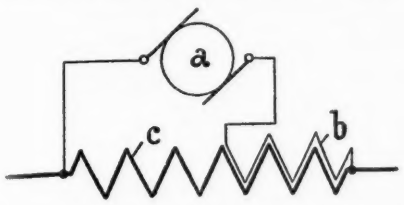
ALUMINUM WELDING.

Hitherto one of the great obstacles to the extended use of aluminum both in mechanical and electrical work has been the difficulty of obtaining a sound mechanical joint. Owing to its greatly reduced cost aluminum is proving a strong competitor to copper for electrical purposes, especially for transmission lines. Attempts have been made to weld aluminum electrically, but hitherto most of the experiments in this line have proved abortive. The weld when made was found to be brittle and the strength of the metal was considerably reduced, in some cases as much as ten per cent. Soldering has also proved practically impossible with this metal on account of the formation of a thin film of oxide on the surface of the metal. This film although almost imperceptible cannot be reduced by means of a flux. Mechanical removal is also impracticable, for immediately the old surface is scraped or cut a new film of oxide is instantaneously formed on the new surface, effectively preventing the permanent adhesion of the solder. A new process, however, of welding aluminum has lately been discovered, which bids fair to be a permanent success. Sherard Cowper-Cowles, the well-known electrometallurgist, is the inventor of the new process, which utilizes the fact that aluminum readily becomes coated with a film of oxide, and employs a compact patent welding machine to make the joints. The ends of the rod to be jointed are faced square and butted end to end, and a blowpipe flame is applied at the joint, which rapidly produces a skin of oxide. The fused metal is retained within this skin. By means of a spring mechanism released by a catch the ends of the rods when sufficiently fluid are brought violently together; the oxide skin bursting at the point of contact is driven out by the pressure and the clean molten metal unites and makes a perfect joint, with the formation of a collar which may be removed if it is desirable to obtain a uniform diameter. The machine can be supplied with coal-gas or producer-gas blowpipe, or a benzoline lamp for field work, in which latter case it can be packed in a box measuring eighteen inches by seven inches, and weighing only nineteen pounds. The complete outfit costs from fifty dollars up, according to the size of the welds to be made. In a series of tests on twelve consecutive welds made by this machine, all the fractures occurred at a considerable distance from the weld, showing that the welding process had not caused the metal to deteriorate.—*Abstracted from The Electrical Times (London), April 15.*

NEW FRICTION COMPENSATION FOR AMPERE-HOUR METERS.

Ampere-hour meters, in which an armature connected in a shunt rotates in a permanent magnetic field, show minus errors resulting from friction at small loads, if the indications are correct at full load. These errors, which amount

to about three per cent at one-tenth load, are prevented by the following arrangement: In the accompanying figure *a* is the armature of an ampere-hour meter with a resistance of forty ohms, *b* a resistance in the armature circuit made of material with a positive temperature co-



efficient, as copper or nickel, of five ohms at a temperature of twenty degrees, and *c* a shunt in the main circuit. The resistance may be a thin wire, insulated with enamel, for instance, and wound around the shunt. If the temperature of the shunt rises from twenty degrees at one-tenth load to 100 degrees at full load, the resistance will also assume this temperature, and the resistance of the armature circuit will increase from forty-five ohms to 46.6 ohms. Therefore, the armature will take about 3.5 per cent less current at full load than at one-tenth load; in other words, it will rotate 3.5 per cent faster at one-tenth load. The minus errors occurring at small loads are thus prevented in a simple and cheap manner and with a minimum loss of energy.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), April 8.*

TEST OF MERCURY RECTIFIERS.

In many establishments connected to alternating-current central stations, mercury rectifiers offer decided advantages over rotary transformers. In view of this fact, tests of such rectifiers have been made in the Physico-Technical Imperial Institute with respect to their method of operation, efficiency and life. Rectifiers for single and polyphase currents were supplied by the Westinghouse Electric Company for the purpose. The full-load current density for all of them was 10.5 amperes and the highest admissible alternating tension 250 volts. In order to be able to measure the drop in tension in the single-phase rectifier conveniently, it was first loaded with direct current, the two iron electrodes being connected in parallel as anode, and the mercury being made the common cathode. The drop in tension amounted to eighteen volts at three amperes total current, and fifteen volts at 10.5 amperes. The same drop in tension takes place also with alternating current and is the only notable loss of the rectifier, and accordingly the degree of efficiency for any operating tension may be easily determined. The single-phase rectifier was tested with current of 240 volts, the load being incandescent lamps and a choking coil inserted between the lamps and the transformer. The choking coil in the direct-current circuit is absolutely necessary with the single-phase rectifier, as without it the pulsating direct current would sink to zero in each period, and the operation of the rectifier would be interrupted. The available direct pressure, measured dynamometrically, was about eighty-five volts. Measurements were made in the different parts of the circuit with hot-wire and dynamometric instruments. A polyphase rectifier has been in operation for 2,250 hours under full load and is still intact.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), April 1.*

An Up-to-Date Electric Kitchen.

At the ninth annual convention of the Iowa Electrical Association, held at Cedar Rapids, Iowa, April 21 and 22, Mrs. L. D. Mathes exhibited some photographs of her electric domestic appliances, two of which are reproduced herewith, to illustrate her paper on "Applications of Electricity in the Modern Home," which was digested in our last week's issue, page 793.

On the shelf of the electric cabinet shown in Fig. 1 are a chafing dish, large double boiler, coffee percolator, and a smaller boiler, all electrically heated. The back of the cabinet is utilized as a switchboard and contains also the outlets for the connecting cords and plugs. On the flat top of the cabinet are an electric spider or frypan, and an electric toaster and broiler. To the right is the large glass-fronted oven demonstrated at the convention, and underneath it is a smaller oven. To the extreme right is a new fireless oven designed by Mrs. Mathes and a Mr. Steckline, one of her husband's employes.

FIG. 2.—THE LAUNDRY MANGLE.

An ordinary mangle driven by an electric motor requisitioned from her husband's central station is illustrated in Fig. 2. An electric flatiron is shown under the machine.

FIG. 1.—MRS. L. D. MATHES' ELECTRIC KITCHEN.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Automatic Telephone Equipment.

The increasing demand for intercommunicating telephone service throughout the country has induced the Western Electric Company, which supplies all the equipment used by the entire Bell system, to place on the market two types of metal automatic intercommunicating telephone equipment. These sets are made in two types, a non-flush set for mounting on a wall and a flush set for mounting in a wall, both compactly mounted in a fireproof iron case, having a hard, durable, black japanned finish with nickel trimmings. The attractive appearance of the set makes it in keeping with the furnishings of any room.

FIG. 1.—INTERCOMMUNICATING TELEPHONE, NON-FLUSH WALL SET.

The non-flush wall set has all the telephone apparatus mounted on a door, which is hinged at the bottom so that it can be swung down as in Fig. 2. To make the apparatus accessible for maintenance and inspection, all current-carrying parts, including the transmitter, are insulated from the case and a concealed binding-post receiver is used. A noticeable feature of this set is the dustproof side used in connection with the switch hook to prevent dust from entering the case through the switch-hook slot.

The flush wall set, Figs. 3 and 4, not only possesses all the features of the non-flush type, but in addition the front of the set is removable from the back, thus permitting the back of the set to be used as an outlet box. This set may be placed in a residence or building while the building is under construction, or in an old building before the wiring is started, and the front of the set containing all the working parts fastened in place when convenient. This will certainly appeal to contractors and those installing sets in old or new buildings.

FIG. 2.—ARRANGEMENT OF NON-FLUSH WALL SET.

The superintendent's call equipment

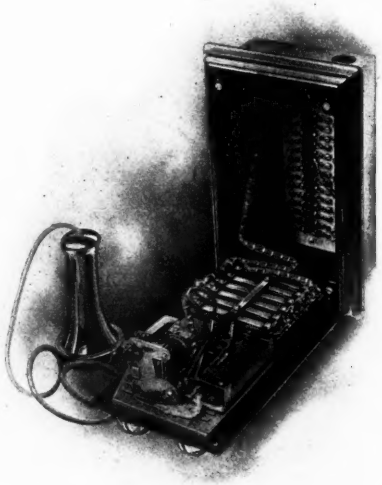


FIG. 4.—ARRANGEMENT OF FLUSH WALL SET.

can be furnished for any of the stations to enable a general call being given throughout the system for the superintendent, who may be in one or another of the departments.

Either full metallic or common return wiring may be used to connect the stations together. The former renders the system less subject to inductive disturbances and cross talk, and is particularly recommended when the system is to be connected to an exchange or outside service.

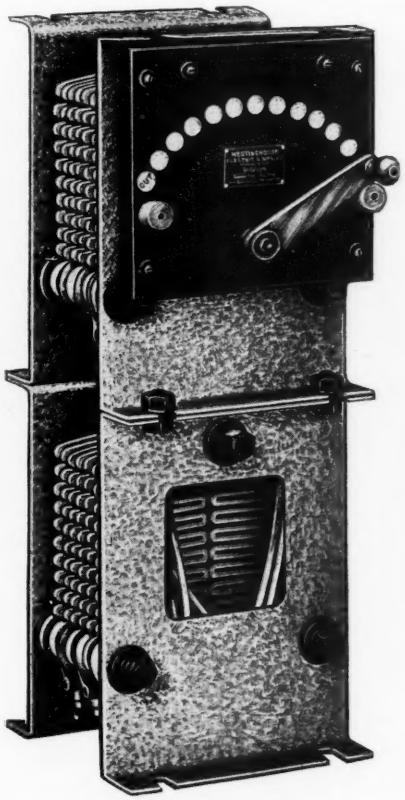
FIG. 3.—FLUSH WALL SET.

If the maximum distance between any two stations is 500 feet or less the ringing battery should have a potential of about four volts and the talking battery a potential about the same as this. With 1,200 feet as a maximum distance the potential of the ringing battery should be five volts and of the talking battery four volts. With 2,000 feet as the maximum distance the ringing battery should have a potential of seven volts and the talking battery of six volts.

These sets have a capacity of twelve stations, each set being provided with twelve buttons, one button for each station, and the name-plate is provided with a space opposite each button for designating the name or location of the station associated with the button. For the sake of convenience the same button is used for signaling the station desired and for establishing telephone connection.

Battery-Charging Rheostats for Direct Current.

For use wherever a small storage battery is maintained, as in public and private garages where only constant voltage direct current is available, a decidedly serviceable storage battery rheostat is now being sold by the Westinghouse Electric and Manufacturing Company. Some form of resistance must be employed since the voltage at the beginning of the charge is less than is required when the batteries are fully charged, and it is therefore necessary to reduce the voltage, usually by an adjustable series rheostat. The voltage applied to the battery should be raised gradually from the minimum value at the beginning to about 2.7 volts per cell at the end of the process.



WESTINGHOUSE BATTERY-CHARGING RHEOSTAT.

The illustration shows a type "DB" battery-charging rheostat for forty to forty-four cells which is capable of carrying fifty amperes on any position; other rheostats are supplied for the same current capacity and to charge ten to fourteen cells from 110 to 120-volt circuit.

To select a charging rheostat for a given service, the circuit voltage, the minimum allowable battery voltage and the charging current in amperes must be known. The required rheostat resistance can then be computed as follows:

$$\text{Resistance of rheostat} = \frac{\text{Circuit Volts} - \text{Battery Volts}}{\text{No. Amperes Charging Current}}$$

The battery voltage is the product of the number of cells in series and the volts per cell. For example, to charge a battery which has thirty-six cells connected in series, at a maximum rate of 7.5 amperes from a 110-volt circuit, the minimum voltage or the initial charging voltage being two volts per cell, the resistance in the rheostat would have to be as great as $\frac{110 - 36 \times 2}{7.5} = 5.07$ ohms approximately, and therefore the standard rheostat with 5.5 ohms resistance would be required.

Although these rheostats are rated as for 110 to 120 volts it is possible to use them on higher voltages, provided the resistance is great enough to keep the current within the maximum allowable amperage for the batteries, but of course the current capacity of the rheostat must not be exceeded.

The rheostats have a standard finish of black marine for the face plate, the resistance grids are coated with aluminum paint, and the supporting frames are galvanized, making rusting impossible. The general effect is such that it can be mounted near any switchboard without forming a displeasing contrast.

The resistance is of the grid type and is rigid, compact and substantial, insuring a long life if not abused. There are thirteen steps by which the resistance can be adjusted, giving ample opportunity for maintaining the current at the correct value. The entire construction is particularly well suited for operation by persons unfamiliar with electrical appliances.

"Multilet" Outlet Box.

A new outlet box, known as the "Multilet," see Fig. 1, has been brought out by the Sprague Electric Company of New York. Contractors and dealers will readily appreciate the value of its simplicity, as it enables them to meet all demands without carrying a large variety of stock. The "Multilet" is a stamped steel box made in two sizes with a set of covers for each size. The box has six outlets, as follows: One in each end, two on one side, one on the other and one in the bottom. The "Multilet" box and its covers enable the wireman to make any necessary combinations for use with rigid conduit, Greenfield flexible steel conduit or Greenfield flexible steel-armored conductors. No special fittings are required for special work, and this makes it possible for the wireman to complete his work without expensive delays.

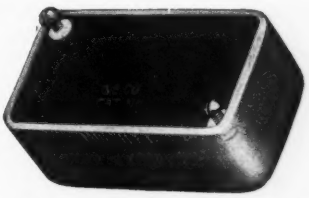


FIG. 1.—MULTILET OUTLET BOX.

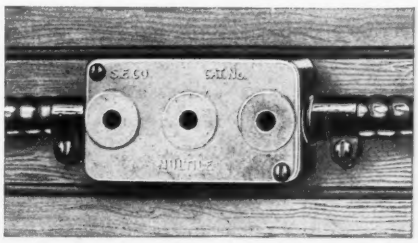


FIG. 2.—PORCELAIN COVER.

While the "Multilet" is small, ample space is provided in the box for the wires.

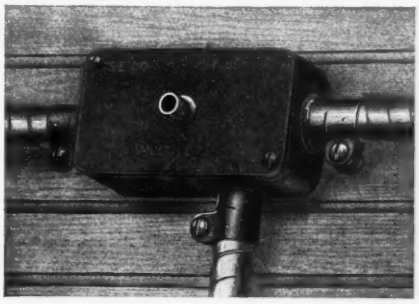


FIG. 3.—MALE NIPPLE COVER.

It accommodates standard fittings, such as receptacles, rosettes, etc., and, with the exception of porcelain covers, is made with a galvanized or enameled finish.

FIG. 4.—BENJAMIN RECEPTACLE COVER.

Some of the "Multilet" covers are illustrated in Figs. 2, 3 and 4.

A Model Aluminum Lightning Arrester Installation.

The Schenectady Power Company's system is protected by an interesting and thoroughly modern installation of aluminum lightning arresters. This company has a forty-cycle, three-phase generating station on the Hoosic River, near Schaghticoke, N. Y., from which some 1,200 kilowatts at 32,000 volts is transmitted twenty-one miles to the works of the General Electric Company at Schenectady, N. Y. This plant was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, March 27.

The transmission lines are in duplicate and are supported on specially constructed steel towers, the General Electric link type of suspension insulator being used. Although the line crosses both the Hudson and Mohawk Valleys at points where lightning is very severe, no special protecting apparatus was designed to meet these conditions. Arresters of standard design are in use, and they have given entire satisfaction since they were installed. A three-eighths-inch stranded steel wire, grounded at each tower, is supported above the lines at the tops of the towers.

The generating station and the substation at the Schenectady end are both equipped with General Electric aluminum arresters of the latest design. The construction of these arresters is very simple. A series of aluminum cones, each being partially filled with an electrolyte, is rigidly held together, the complete unit being immersed in oil in a steel tank and connected to ground and line. An adjustable horn gap is placed between the arrester and the line.

The useful characteristic of the type of aluminum arrester used in this installation is its critical voltage. This critical voltage depends upon the formation of a thin film on the surfaces of the aluminum cones. This film normally has a very high resistance, and up to its critical-voltage point allows exceedingly low currents to pass, but above this point the current is limited only by the internal resistance of the electrolyte. The closest analogy to this action is found in the well-known safety valve of the steam boiler, in which the steam is not permitted to escape until the pressure rises to a given value, and is then released for all pressures above this value. On the aluminum plate there are myriads of these safety valves, so that if the electric pressure rises above the critical voltage, a free discharge takes place equally over the entire surface.

When the arrester is not in operation the film dissolves slightly in the electrolyte, and in order to keep the film in good condition provisions are made so that the

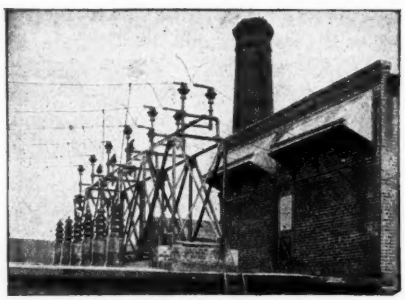


FIG. 1.—INCOMING LINES OF SCHENECTADY TERMINAL, SCHENECTADY POWER COMPANY.

arrester can be momentarily connected to the line each day.

The General Electric arresters on the Schaghticoke system are designed to discharge continuously for half an hour, although in actual tests arresters of this type have discharged continuously for two hours. Half an hour, however, is

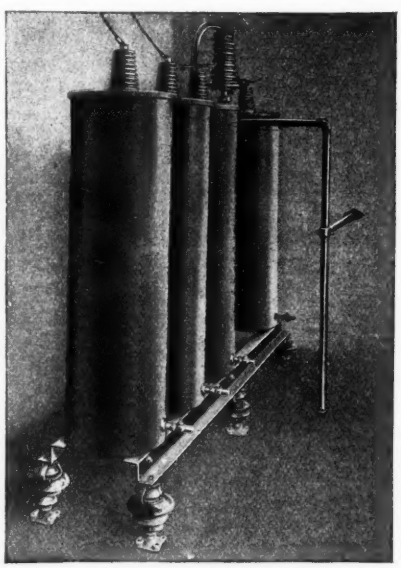


FIG. 2.—INTERIOR OF MONSTER COMPARTMENT.

considered sufficiently long to remedy whatever trouble may be on the line. When a phase becomes grounded and the arrester begins to discharge, an alarm bell attracts the attention of the operator. This discharge alarm consists of a single aluminum cell placed in the ground connection to the arrester proper, and an ordinary electric bell in shunt with the cell, the bell ringing only when current passes to ground.

The accompanying illustration, Fig. 1, shows the incoming lines at the Schenectady terminal, and the substantial manner in which the construction is carried out. The main lines enter the station through six roof-entrance bushings, the arresters being installed in the raised portion of the station shown at the right of the illustration.

In Fig. 2 is shown the interior of the arrester compartment. As this is a non-grounded neutral system, four stacks of cones are used, a multiplex connection giving equal protection between the lines as well as between line and ground. The transfer switch shown between the third and fourth tanks in the illustration is used to interchange the connections between these stacks of cones.

The installation is very compact, the distance from the floor to top of insulators being about eighty-five inches, and the length of the supporting frame is about ninety-three inches.

At the Schaghticoke end of the line the arresters are installed in fireproof compartments in the rear of the switchboard, while the horn gaps are located on the roof of the power house.

Similar installations of these arresters have been made on other high-tension transmission lines in different parts of the country, notably on the system of the Southern Power Company and the high-tension lines of the Animas Power and Water Company in Southern Colorado. The operating record in this last installation is an extremely interesting one, the number of shutdowns due to lightning being reduced eighty-eight per cent in a single year. In this, as in other installations, the arresters have required no attention whatever except the regular charging required to keep the film in good condition.

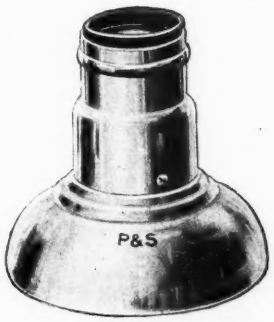
Report of the American Bell Telephone Company.

The American Bell Telephone Company, incorporated under the laws of Massachusetts, has filed with the Massachusetts secretary of state a statement of its financial condition, dated March 30, 1909, which compares with its last year's statement as follows:

	1909.	1908.
Assets.		
Stock of Am. Tel. & Tel. Co.	$22,110,400	$27,110,400
Cash and debts receivable.		5,000,000
Total	$22,110,400	$32,110,400
Liabilities.		
Debts	$ 17,000	$10,000,000
Balance of outstanding assets after meeting above item held in trust for the Am. Tel. & Tel. Co.....	22,093,400	22,110,400
Total	$22,110,400	$32,110,400

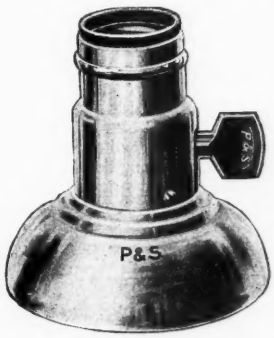
Key and Keyless Receptacles for Tungsten Lamps, Etc.

The firm of Pass and Seymour, Inc., Solvay, N. Y., manufacturers of electrical specialties and porcelain of special design, announces that their P & S No. 62350



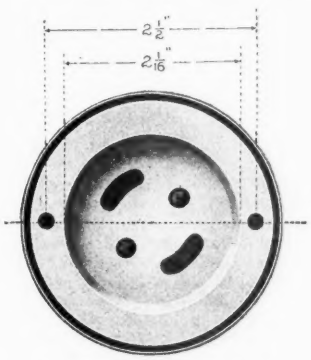
KEYLESS RECEPTACLE.

key, and 62351 keyless, large base receptacles, which are particularly recommended for use with tungsten lamps, etc., are now



KEY RECEPTACLE.

on the market. These were approved by the National Board of Fire Underwriters on April 7 last. The mechanism of the



BASE OF RECEPTACLE.

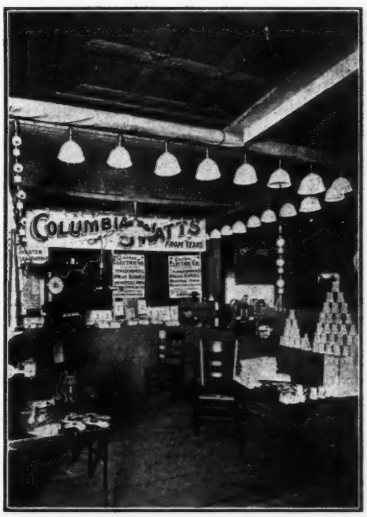
key socket is of the P & S double-pole construction. This is the only socket which has an insulated mandrel. These receptacles are provided with large recessed bases to be used in concealed work, the base being recessed to take care of the end of tubes or conduit, projecting from the ceiling.

Central Electric Company Exhibit at Cedar Rapids.

One of the brightest booths at the Cedar Rapids (Iowa) Electrical Show, described in our last issue, was that of the Central Electric Company, Chicago.

The booth was outlined with Opalux shades and reflectors in combination with tungsten lamps, affording a very effective demonstration of the reflecting powers of this glassware.

A particularly interesting exhibit was a collection of five-watt, four-candlepower, twelve-volt Columbia tungsten lamps, operating from a Central Electric transformer, stepping from 110 to twelve volts.



CENTRAL ELECTRIC COMPANY'S EXHIBIT AT LOUISVILLE ELECTRIC SHOW, APRIL 12-24.

These were the only five-watt lamps on exhibition and attracted a great deal of attention from central-station managers, especially those interested in the problem of selling current for signs.

A "Tungstolite" fixture, equipped with forty-watt lamps, was mounted at the center of the booth and a complete display was made of the new Central "tungstometer," a convenient pocket meter for measuring current consumption of incandescent lamps on either alternating or direct-current circuits.

Other specialties shown were Okonite and D. & W. products; Banner insulated wire; high-efficiency silico-vanadium steel transformers and materials and parts used in making them; the P-M air-break and oil-break remote-control switches for alternating and direct-current service up to 2,500 amperes and 6,900 volts; the new Central time switch (shown in operation), and many others.

The exhibit was in charge of H. W. Young, J. J. Boyd and F. W. Switzer, of the Central Electric Company, and H. W. Berning, of the Columbia Incandescent Lamp Company.

Axle Train-Lighting System With a Single Generator.

A system of train lighting, which is a combination of the head-end system and the individual axle lighting method, now so commonly used, has been invented by W. J. Behan, of Merriam Park, Minn. Mr. Behan is a graduate in electrical engineering from the University of Wisconsin, and for fifteen years has been an electrical engineer for the Northern Pacific Railroad. For the last five years he has worked upon the system just perfected.

In this system but one dynamo is used and it is mounted in the baggage car. It is driven by means of self-adjusting belts from the axle of the truck at one end of the car. The generator is entirely within the car, where it and the automatic regulating apparatus can be readily inspected. The equipment does not take up very much room, however, and can be enclosed to prevent unnecessary disturbance with it. Storage batteries are provided for supplying the load when the train is stationary.

A recent test of the system with a four-coach train showed that it was fully capable of brilliantly lighting the train at all times. Its initial and maintenance cost is said to be but a small part of that required for the regular axle system, over which it has the further advantage of accessibility for inspection and repairs. Compared with the steam-driven head-end method, it is claimed to cost about one-half. N.

A Machine for Refilling Incandescent Lamps.

The Dwyer Machine Company, Lynn, Mass., manufacturer of photometers and machinery for manufacturing and testing lamps, announces that it has placed on the market a machine which is designed to enable central-stations to renew their old burned-out lamps. Filaments are supplied and the lamps can be refilled with filaments having an efficiency of 3.1 watts per candle or 3.5 watts as desired. The base of the lamp is not disturbed, and it is necessary only to make a hole in the lamp three-sixteenths of an inch in diameter by removing the tip. The company states that the machine also thoroughly removes any blackening from the bulb, and that the lamps when refilled compare favorably in appearance with new lamps.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, APRIL 24.—It has been recognized for some years past by electricity supply authorities in the United Kingdom that the excessive cost of wiring houses has greatly hampered any rapid acquisition of new consumers. In fact it has been regarded as almost hopeless with existing methods to obtain the custom of the small consumers who, by reason of their numbers, contribute so largely to the revenue of the gas companies. For a long time, therefore, the energies of electrical manufacturers have been turned in the direction of the evolution of cheaper systems of wiring in the hope, thereby, of securing what are known in the trade as the "six-light" and "twelve-light" man. Quite a number of such systems are now on the market, all having the one fundamental principle, viz., that the wiring is to be fixed on the surface, thus doing away with the heavy initial cost of wood casing or metal conduit. While the makers of some of these systems are content merely to cover the wires with an outside braiding which has been rendered more or less fireproof, others prefer some method of armoring in order to make the wires proof against rough mechanical handling. A system of surface wiring on this principle has recently been adopted in the new buildings of the Local Government Board.

That controversial question of combining an electricity works with a refuse destructor has recently been under discussion at Glasgow on the occasion of the publication of the results of the first year's working of the combined undertaking at Greenock, which was the last of its kind to be installed and contains the very latest developments in the matter of refuse destruction. From the experiences at Greenock it certainly appears that the objections to the combination from what may be termed the æsthetic point of view have been entirely overcome, as the design of the destructors there precludes any possibility of dust or particles finding their way into the engine house, there being a system of water-sealed doors and automatic charging by which the refuse is deposited directly into the furnace. The electrical engineer at Greenock now favors the combination of electricty works and refuse destructor and that in the interests of efficiency the combined installation should be under the control of the electrical engineer.

Prof. G. Kapp, head of the electrical engineering department of Birmingham University, has been nominated as President of the Institution of Electrical Engineers, for the 1909-10 session.

In connection with the new Imperial College of Science the Institution of Electrical Engineers is co-operating in the matter of providing an electrical engineering laboratory at a cost of $100,000 in memory of the late Lord Kelvin. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, APRIL 24.—A somewhat extensive network of power lines has been recently put in operation in the north of France in the Pas de Calais department, and the lines cover a number of industrial centers. The current for the network is supplied from a large central station erected at the locality of Pont-à-Vendin, and it is under the control of the Lone Mining Company. At present there are about forty miles of power lines in use, and the system is operated at 45,000 volts, three-phase. From the main station there are run two separate lines to the localities of Bauvin and Douai, and they pass along the canals for most of the traject. The high-tension lines are mounted on iron trellis work poles, using a 240-foot span as a general rule. In the cases where the lines cross the canals, they are mounted at eighty feet height. The present plant has been installed by the French Thomson-Houston Company.

Among the recent electric traction enterprises in Austro-Hungary, I note that a concession has been granted to the communes of Voklamarkt and Frankenburg for a narrow-gauge electric railroad line running between these places.

The city of Fiume, on the Adriatic, is taking measures to increase the tramway lines, which are already quite extensive, and one of the principal sections is to be a suburban line running to the frontier of Istria. A. DE C.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

HARNESSING THE MISSISSIPPI—The North American Company has secured extensive water rights near Keokuk, Iowa, to generate electrical energy for transmission to St. Louis and other large cities. Work is being pushed, it is reported, under the direction of V. N. Powelson, former president of the Union Electric Light and Power Company, of St. Louis. The North American Company has contracted for 60,000 horsepower annually for ninety-nine years, beginning in 1912.

BIG MERGER OF ELECTRIC AND GAS COMPANIES AT JOHNSTOWN, PA.—The Johnstown Electric Company of Johnstown, Pa., has increased its capital from $1,000 to $1,200,000. This company will be the merger of the gas and electric companies of Johnstown, which are being mergered by Emmet Queen of Pittsburg. All the seven companies have agreed to the merger, the Johnstown Natural Gas Company having been purchased outright from the Crawfords of Pittsburg, by Mr. Queen.

NEW TELEPHONE COMPANY—A dispatch from Albany, N. Y., says that the Public Service Telephone Company with a capital of $10,000,000, consisting of $5,000,000 preferred and $5,000,000 common, has recently been incorporated there. The company will operate lines of telephone and telegraph, telautograph and other electrical lines of communication in New York state, Canada, and elsewhere. The directors are: John A. L. Campbell, Robert F. Routh, Joseph P. Hauck, Russell H. Robbins, Albert J. Appel, of New York city; William J. Ganzel of Carwood, N. J.; J. Keim Hetch of Brooklyn.

THE GENERAL ELECTRIC COMPANY TO EXTEND ITS TOLEDO PLANT—That the General Electric Company will now build extensive additions to its Toledo (Ohio) plant seems to be an assured fact. After a number of weeks of wrangling the City Council has finally agreed to vacate portions of Mulberry Street as requested by the company, upon condition that the concern shall put in improvements amounting to not less than $300,000, as originally proposed by the company. The architect has been summoned to Toledo and the work will be hastened to completion within the next few months. H.

NEW TRACTION PROJECT IN KENTUCKY—Incorporation papers of the Cincinnati, Louisville, Lexington & Maysville Traction Company, with $10,000,000 capital stock, have been filed here by W. T. S. Blackburn, president of the company, and one of the promoters. The construction work will be started this year and rushed to completion. The plans call for the construction of a complete electric traction system to be operated between Cincinnati and Lexington and Maysville and Louisville, crossing each other at Dry Ridge. The line will be about 250 miles long and will traverse the counties of Boone, Kenton, Mason, Campbell, Gallatin, Grant, Pendleton, Bracken, Harrison, Bourbon, Fayette, Nicholas, Clark, Franklin, Scott, Jefferson, Shelby, Henry and Owen. It will tap a large and rich section of the state.

REHABILITATION OF POWER CONCERN—The Whitney Reduction Company, Charlotte, N. C., which has already expended $5,000,000 on its projected 60,000-horsepower plant at Whitney, on the narrows of the Yadkin River, in Stanly County, will probably soon be on its feet again and able to resume work which was stopped eighteen months ago because of financial difficulties. A further sum of $5,000,000 will be necessary to carry out the original plans. J. B. and B. N. Duke, the tobacco magnates, who are already interested in the Southern Power Company, have been negotiating with the promoters and receiver of the Whitney Company, and it is believed that they will furnish the money necessary to complete the work and secure control of the property, being chief stockholders of the reorganized company. This would bring about an alliance, possibly a merger, between the Whitney Company and the Southern Power Company, the two concerns together controlling developed and undeveloped waterpowers within a radius of fifty miles of Charlotte to the amount of fully 300,000 horsepower.

POWER COMPANY BOND ISSUE—The Niagara, Lockport & Ontario Power Company, which is closely affiliated with the Ontario Power Company, is delivering 35,000 horsepower, and this amount will be increased to 60,000 by January 1. The company purchases its power under contract from the Ontario Power Company, and its property comprises an extensive system of transmission lines through the northwestern part of New York state, delivering power as far as Syracuse. It is free of competition and its contracts run from ten to thirty years, mostly with large power consumers (railroads, street railways, electric light and steel plants) in Rochester, Syracuse, Auburn, Lockport and West Seneca district. One of the most important con-

sumers in the Buffalo district is the Lackawanna Steel Company. The entire authorized amount, $5,000,000, of first mortgage five per cent bonds is outstanding. Pingree, McKinney and Company, of New York city, are offering a block of these bonds to net 5.45 per cent. The bonds are secured by a direct first lien on the entire property, representing a total cost of about $7,250,000, or forty-five per cent in excess of the bonds. The security is further increased by sinking fund which will retire all the bonds before maturity.

LIGHTING AND POWER.

(Special Correspondence.)

MATTOON, WIS.—F. C. Duchac and Company will install an electric-light plant. C.

CENTRAL CITY, NEB.—This city will vote on the establishment of a municipal electric-light plant.

FLATONIA, TEX.—Paulus and Rhodes will establish an electric-light plant and grist mill here.

MIDDLEBURG, PA.—The Middlecreek Electric Company is erecting a large steam power plant in Sunbury.

LOS ANGELES, CAL.—The United States Lighting Company has been incorporated with a capital of $10,000.

DENVER, COLO.—The South Platte Power Company has been incorporated with a capital stock of $50,000.

MT. CALM, TEX.—The Mt. Calm Water and Light Company has been incorporated with a capital stock of $5,000.

SAPULPA, OKLA.—This city has voted the issuance of $40,000 in bonds for an electric-light plant and waterworks.

MIZPAH, MINN.—William Potter has been granted a fifteen-year franchise to supply the village with electric light and power. C.

NEWCASTLE, PA.—The Ambridge Heat, Power and Light Company has been formed by Ambridge men with a capital of $150,000.

IOWA CITY, IOWA—Franklin Benjamin, of Galesburg, Ill., will erect a new electric-light plant here to fight the existing company.

LAKE PRESTON, S. D.—The Lake Preston Milling Company has been granted a twenty-year franchise to maintain an electric-light plant. C.

PEABODY, MASS.—The citizens of this town have decided by an overwhelming vote to keep their municipal lighting plant and improve it.

WILMINGTON, DEL.—The Ambridge Heat, Light and Power Company, Ambridge, Pa., has been incorporated with a capital stock of $150,000.

DENVER, COLO.—The South Platte Power Company has been incorporated for $50,000 by W. J. McConnell, C. L. Barthen and E. J. Moore, all of Denver.

PORTLAND, ME.—The Monticello Electric Company, of Monticello, has been organized, with $5,000 capital, for the purpose of accumulating, storing and supplying electricity for lighting, heat and power.

SAN ANGELO, TEX.—The Waterworks and Electric Light Company is planning improvements to the system that will cost $25,000. Part of the improvements figured on is a Corliss engine of 750 horsepower.

NEW YORK CITY, N. Y.—The Port Jervis Light and Power Company, Port Jervis, N. Y., has been incorporated with a capital of $300,000; directors, J. B. Crowell, R. C. Maroney, J. E. Bailey, W. E. Freeman and J. V. Tarney.

HANFORD, CAL.—The Tulare Lake Irrigation and Power Company has been incorporated here with a capital stock of $2,000,000 by A. C. Palladine, B. R. Palladine, J. W. Barbour, T. L. Hannah and C. W. Barrett.

SPRINGFIELD, OHIO—The Springfield Light, Heat and Power Company has purchased a tract of land along Buck Creek, west of Fountain Avenue, and will erect a new power plant that, when completed, will cost $200,000.

ATLANTA, GA.—A charter has been asked in the Superior Court for the Coosawattee and Mountaintown Rivers Power and Improvement Company, with a capital stock of $50,000. The incorporators are William M. Scott, of Atlanta, and E. W. Watkins, Sr., and E. W. Watkins, Jr., of Gilmer County.

GUANAJUATO, MEXICO—The transmission line which the Guanajuato Power and Electric Company is constructing to Silao will soon be completed and the town will be furnished with lighting current and power for small motors. The company will have its new plant at Tanidacuaro, state of Michoacan, in operation in a few months. The new plant will have a capacity of about 9,000 horsepower, increasing the present total capacity to 20,000 horsepower. The new plant will cost about $800,000, Mexican. The company contemplates furnishing power for a large number of towns and mining camps about the Guanajuato district. D.

LANSING, MICH.—At a meeting of the directors of the Michigan Power Company the expenditure of $125,000 for improvements upon the Lansing plant was authorized. The improvements will be commenced at once, and will be completed by November 1.

DANVILLE, PA.—The Columbia Power, Light and Railways Company will install a 500-horsepower waterwheel at its Irondale plant, and also a 300-horsepower steam engine for use when the water is low in Fishing Creek. A 250-kilowatt railway generator will also be installed.

TRENTON, N. J.—A certificate of incorporation has been granted to the Interstate Light and Power Company, Jersey City, with a capital stock of $750,000. The incorporators are H. O. Coughlan, S. A. Anderson and John R. Turner. The company is to generate and distribute electricity for light, heat, power, etc.

NILES, MICH.—The Indiana & Michigan Electric Company has commenced the erection of a substation here. Electric power will be furnished from the company's dams in the St. Joseph River at Buchanan and Berrien Springs at low prices, and it is thought will be the means of bringing manufacturing concerns to Niles.

PASADENA, CAL.—The Lytle Creek Power Company has decided to increase its capacity by one-half and to extend its system throughout the residence section of the city. To cover the cost of this it was decided to vote a bond issue of $300,000. The company has the city contract at present and this, with the rapid increase of electric signs in the downtown district, has caused them to decide on this move.

HENDERSONVILLE, N. C.—The Green River Power Company, incorporated with $100,000, has headquarters at this town, and will develop an excellent mountain waterpower, primarily to furnish power to Hendersonville, and also to distribute power to a large cotton mill which has been organized, and to dispose of power to other corporations, and to supply power for the proposed Hendersonville street-railway system. L.

JERSEY CITY, N. J.—A meeting was recently held at Meyer's Hotel by the Citizens' Light, Heat and Power Company, toward the forming of a $500,000 corporation, for the purpose of erecting a light, heat and power plant to supply the city of Hoboken at a charge less than is now charged for electric lighting by the Public Service Corporation. Articles of incorporation were signed by those present and $32,250 worth of stock was subscribed for on the spot.

SYRACUSE, N. Y.—Judge George W. Ray, in United States Court here, on April 21 last, issued an order granting permission to the receivers of the Hudson River Waterpower Company to borrow $50,000, to pay interest on bonds of $2,000,000 secured by mortgage to the Trust Company of America. The petition was opposed by attorneys for New York, Boston, Schenectady and other bondholders. It is said by the officers that if the interest is paid the company can continue.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has taken out a permit for the construction of a brick steam powerhouse on River Avenue at the end of Wealthy Avenue. The cost is given at $20,000. This is the beginning of the active work which is to create the big steam power plant of the company which is to ultimately develop 30,000 horsepower and to be used as an auxiliary plant to the waterpower plant, for special service during low water periods of the year.

HOBOKEN, N. J.—The newly organized Citizens Light, Heat and Power Company, of Hoboken, has made an application for a franchise in that city. It agreed to enter into a contract with the city to light 285 street lamps at $70 per lamp per year. The Public Service Corporation, which now enjoys a lighting monopoly, offered to light the city for one year at its present contract price of $100 per lamp; at $90 per lamp on a three-year contract and at $80 per lamp on a five-year contract. The Citizens Light, Heat and Power Company was recently incorporated by Hoboken men with a capital stock of $500,000. No shareholder can own more than $1,000 worth of stock. In the event of securing a franchise the company promises to lay its conduits, string wires and complete its plant in a year.

PROVIDENCE, R. I.—The bill to incorporate the Blackstone Valley Gas and Electric Company has been placed on the House calendar without the amendment which would prohibit the company from carrying stock of the Providence Gas Company and the Narragansett Electric Lighting Company. Only three amendments proposed to the committee were recommended. One limits the capital stock to $6,000,000, another limits the bond issue to the same amount, and the third allows the new corporation to acquire property of another corporation if sanctioned

by an eight-tenths vote of the stockholders of that corporation. The bill as reported is looked upon as virtually a victory for Stone & Webster, of Boston, who for a year have been fighting for the right to manage various Rhode Island companies.

MANISTEE, MICH.—At a recent meeting of the board of supervisors, a resolution was passed intrusting its members with the duty of formulating a franchise for developing the power of the Manistee River by the Manistee County Electric Company. William T. Hatch was elected chairman of the committee.

ELECTRIC RAILWAYS.

(Special Correspondence.)

ATLANTA, GA.—The Georgia Railway and Electric Company has been granted authority to issue $1,250,000 worth of bonds.

SALT LAKE CITY, UTAH—All possible speed is now being made with the work of electrifying the Salt Lake & Ogden Railroad.

SAN RAFAEL, CAL.—S. A. Moss has applied for a franchise to construct an electric line between Manazanita Station and Coyote Creek. A.

CHICAGO, ILL.—The receivers of the Consolidated Traction Company are seeking authority to issue receivers' certificates for improvements.

GRAND RAPIDS, WIS.—R. M. Haskett, engineer, Wausau, Wis., has started the permanent survey for the suburban street railroad to Nekoosa. C.

NORWALK, OHIO—The Sandusky, Norwalk & Mansfield Railway Company will build an extension of its road between Shelby and Mansfield.

SIOUX CITY, IOWA—It is stated that all the right-of-way to Spirit Lake, for the Sioux City & Spirit Lake Interurban Railway Company, will have been secured by June 1. C.

SALT LAKE CITY, UTAH—The Salt Lake & Los Angeles Railway Company has been granted a franchise to construct an electric railroad on certain thoroughfares in this city. A.

SPRINGFIELD, MASS.—The local street railway will spend $80,000 this year for renewals and improvements, of which $25,000 is for new motors and electrical equipment on the cars.

NAPA, CAL.—At the annual stockholders' meeting of the Vallejo, Benecia & Napa Valley Railroad Company it was decided to make an extension of the road to Calistoga this season. A.

SIOUX CITY, IOWA—The Sioux City Service Company will expend fully $150,000 in improvements this season, which will be divided between trackage improvements and new machinery. C.

LITCHFIELD, MINN.—The Electric Short Line Railroad of Minneapolis, Minn., has applied to the county board for permission to cross county roads in the towns of Cedar Mills and Cosmos. C.

XENIA, OHIO—A franchise has been granted for an electric railway over the route of the Rapid Transit line to a point near Lucas Grove, where connection will be made with the Dayton & Xenia line.

SALT LAKE CITY, UTAH—The Utah Light and Railway Company has decided to accept the conditions of the Murry franchise and will begin reconstruction work immediately on the Murry lines. A.

PORTLAND, ORE.—The Oregon Electric Railway Company will spend over $200,000 during the spring and summer in improving its lines. The first work to be done will be the ballasting of road beds. A.

WATERTOWN, WIS.—A franchise has been granted at Cobalt, Ontario, Can., to a number of capitalists including several Watertown men, for the construction of an electric railway in the Cobalt silver mining range.

McKEESPORT, PA.—Work is to be started within the next few days on a new electric line to connect Glassport and Clairton, which will include a steel bridge across the Monongahela River. The total cost will be approximately $300,000.

OREGON CITY, ORE.—Promotion of the proposed electric railway from Oregon City to Beaver Creek and other neighboring cities, is being earnestly undertaken by F. M. Swift. Subscriptions to the amount of $65,000 have already been obtained.

HOUSTON, TEX.—The Galveston-Houston Electric Railway Company has practically decided to build its power station between this city and Galveston, at a place where the advantages of water and fuel are well combined. The site has not been definitely decided upon. The plant will cost about $800,000. A town will be built around it. The route of the line which the company purposes to construct is still in doubt, but is expected to be determined shortly.

KLAMATH FALLS, ORE.—The Klamath Falls Land and Transportation Company has applied for a franchise to construct an electric line between this city and Upper Lake. A.

NASHVILLE, TENN.—The Nashville & Crocker Springs Rapid Transit Railway has been incorporated by Lee Guggenheim, Robert Jones, W. F. Webb, J. B. Carr, J. A. Witherspoon, F. Roddy, Goulding Marr and W. W. Moorehead. Its capital stock is $50,000.

HELENA, MONT.—The Montana Rapid Transit Company has been incorporated with $5,000,000 capital to build an electric line from Helena to Butte. J. K. Toole, president; H. G. Pickett, vice-president, and E. C. Day, secretary and treasurer. The line will be seventy-two miles long and cost about $2,000,000. C.

BELLEVILLE, ILL.—The St. Louis and Chester Railway Company has filed papers of incorporation in Recorder Metzger's office. The company is capitalized at $100,000, and will conduct a railway between East St. Louis and Chester, passing through St. Clair, Monroe and Randolph counties.

LAKEWOOD, N. J.—The Lakewood & Seashore Railway Company has been incorporated in Trenton with capital stock of $300,000. The company will take over the business of the Trenton, Lakewood & Atlantic Railway Company, which was organized two or three years ago to construct a trolley line from Trenton to Lakewood.

PORTLAND, ORE.—The Portland, Butte & Baker City Electric Railroad has been incorporated here by local capitalists, the purpose of the company being to construct an electric railroad from Portland to Butte, Mont. According to the officials of the new company preliminary work on the grade of the first forty miles out of Portland will be begun immediately.

HUNTINGDON, IND.—Plans for the reorganization of the Toledo, Wabash and St. Louis electric line are being made, and in a short time the construction of the road may be recommenced. The road will parallel the Wabash, passing through Logansport, Ft. Wayne, Toledo and Defiance. The road was capitalized at Augusta, Me., in 1907, for $6,000,000.

WEATHERFORD, TEX.—Upon the payment of back taxes and penalties the Secretary of State at Austin has revived the charter of the Chicago, Weatherford and Brazos Valley Railway, which had been suspended, and the work of soliciting subscriptions for its construction is progressing favorably here. Promoter Hicks reports a total of $40,000 subscribed so far.

LANCASTER, PA.—The charter of the Christiana & Coatesville Street Railway Company has been received for record in the recorder's office. The capital stock is $400,000, divided into 8,000 shares of the par value of $50. All of the stock is held by W. W. Griest, W. U. Hensel and John S. Graybill, Jr. The president is W. W. Griest and the directors are W. W. Griest, C. Edgar Titzel, J. S. Graybill, Jr., A. E. Ranck, W. H. Simpson and H. E. Senft.

ALBANY, N. Y.—The Triborough Railroad Company of New York city has been incorporated with the secretary of state, to operate a double-track street surface electric railroad two-and-one-half miles long, from the intersection of Canal, Walker and Baxter Streets, in Manhattan Borough, to the intersection of Fulton Street with Flatbush Avenue extension, Brooklyn. The company has a capital of $50,000, and the directors include William Bradley, James E. Gaffney, Henry Steers, of New York city, and William E. Bolte, of Maywood, N. J.

CLEVELAND, OHIO—Cars will run over the first division of the new interurban traction line between Cleveland and Zanesville, Ohio, within fifteen months. The entire line, passing through twelve counties, sixteen cities and many of the villages, will be completed within three years from the beginning of construction. At a meeting of the stockholders the charter of the company was amended in order that the proposed route might include Millersburg, Cambridge and Rittman. The capital stock was increased from $100,000 to $6,000,000, and Secretary Knisely told the stockholders that the work of construction would be started within ninety days. The corporation will hereafter be known as the Cleveland, Barberton, Coshocton & Zanesville Railway Company, the old name, Cleveland, Brooklyn & Elyria Railway Company, being called too indefinite. The company will lay 190 miles of trackage.

BANGOR, ME.—A preliminary survey has been ordered by the Bangor Railway and Electric Company for an extension to the Charleston division of the lines running from Bangor, which will eventually reach Waterville, fifty-two miles west of this city. The extension will begin at East Corinth and will run to Dexter, thence through the towns of St. Albans, Hartland and Canaan, skirting Moose Pond, to Skowhegan; thence over the rails of the Somerset Traction Company, if it can be purchased, or if not, by independent line, to Waterville. This proposed road will link Bangor, by trunk line, to the westward. In connection with the new road a branch line from Dexter north to Dover

and Foxcroft is contemplated. Further than to say that the preliminary survey has been ordered, President John R. Graham, of the Bangor Railway and Electric Company, will not go, excepting to outline the route which the survey will in a general way follow.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

COPPERAS COVE, TEX.—C. W. Clements and others have organized a rural telephone company.

GREGORY, S. D.—The Farmland Rural Telephone Company has been incorporated with a capital stock of $2,000.

GOODRICH, N. D.—The county board has granted a franchise to the Drake-Skogmo Farmers' Telephone Company.

HARRISBURG, NEB.—The Western Nebraska Telephone Company has been incorporated with a capital stock of $2,000.

COUNCIL BLUFFS, IOWA—The Independent Telephone Company will spend from $25,000 to $30,000 in improvements.

SWAINSBORO, GA.—J. M. Snellgrove will construct a farmers' telephone line to connect this city with Summertown.

DENVER, COLO.—A modern telephone system is to be erected at the military post of Fort Logan, at a cost of $10,000.

ALUM WELL, VA.—The McFadden Telephone Company has been incorporated with a capital of $5,000; A. A. McFadden, president. L.

CLOVER, VA.—The Staunton River Telephone Company, capital $10,000, has been incorporated by W. H. Dorin, of Scottsburg, and associates. L.

SILER CITY, N. C.—The Matthews Telephone Company has purchased the Pittsboro, N. C., system, and is making improvements over its entire system. L.

EMPORIA, VA.—The Town Council has granted a franchise to the Home Telephone Company, of Henderson, N. C., which will put in a complete system in Emporia. L.

ALTOONA, IOWA—At an election held here the Rural and Four-City Independent Telephone Company was granted a franchise to erect and maintain a telephone exchange.

PINEORA, GA.—The Effingham Telephone Company has been chartered with a capital of $5,000 to $50,000. It is proposed first to take over several lines running into Pineora. L.

TOLEDO, OHIO—The Ottoville Telephone Company has been incorporated with a capital of $5,000. Lines will be constructed in Putnam, Paulding, Allen and Van Wert counties. H.

REGINA, SASKATCHEWAN, CAN.—The Saskatchewan Government has purchased for cash all the long-distance lines, local exchanges and equipment of the Bell Telephone Company in this Province.

SPRINGFIELD, MASS.—The police department here has recently discovered that the outright cost of their telephone instruments is less than the single yearly rental the department has been paying for them to the New England Telephone and Telegraph Company.

LOS ANGELES, CAL.—Construction managers in charge of the Sunset Telephone Company's improvements at Redondo Beach have notified city officials that they are willing to put their wires underground along Pacific Avenue in the business section if other public service corporations will do likewise. It is stated by the same authorities that $15,000 is being expended in the improvements in progress now.

PROPOSALS.

POST OFFICE, DANVILLE, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until 3 p. m., June 2, for the construction complete of the United States Post Office at Danville, Ky., in accordance with the drawings and specifications, copies of which may be had at the Supervising Architect's office, or at the office of the Postmaster at Danville, Ky.

ELECTRIC LIGHTING, VINCENNES, IND.—The Board of Public Works, Vincennes, Ind., will receive sealed proposals until 2 p. m., June 8, for the lighting by electricity, for a period of ten years, of the streets, alleys, and other public places of the city of Vincennes, with 260 enclosed arc lamps of 2,000-candlepower intensity each, at 466 true watts. Specifications are on file at the board's offices. In addition to the said number of arc lights above specified the contractor shall place in position and connect ready for use on April 29, 1910, not less than 220 incandescent lamps of sixteen candlepower. The contractor shall also bid on furnishing the city electric current required for lighting its public buildings. All proposals must be made on blank forms, to be obtained at the board's offices, and must be accompanied with an affidavit thereto attached, and also with a certified check for $2,000 to insure the execution of the contract for which the bid is made within twenty days from the acceptance of the proposal. Bond to be given satisfactory to the said board for the faithful performance of the contract.

NAVY SUPPLIES—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids up to May 11 next for the following electrical supplies: 100 electric bells, miscellaneous fittings, twenty arc lamps and miscellaneous lighting wire, for delivery at Norfolk (Va.) Navy Yard; and miscellaneous supplies, for delivery at Philadelphia (Pa.) Navy Yard. The schedule number for these supplies is 1200 and particulars can be obtained from the Bureau on application, quoting this number.

EDUCATIONAL NOTES.

SUMMER COURSES AT ARMOUR INSTITUTE—Armour Institute of Technology, Chicago, Ill., announces in a special bulletin a total of sixty-five regular and special courses in engineering and scientific subjects. Particular attention is given to electrical engineering in which, aside from seven courses, equivalent to the regular sophomore and junior work in this line, there are announced twelve special courses ranging from elementary to advanced work; there are also two courses in telephony. In civil engineering a very popular course is that in field-surveying practice given at a camp near Pemone Dam, Wis. A large number of courses are also given in chemical engineering, physics, mathematics, drawing and shop work. The summer session opens on June 21 and continues for six weeks.

HIGHLAND PARK COLLEGE OF ENGINEERING—The Highland Park College of Engineering, Des Moines, Iowa, has published an elaborate catalogue devoted to a description with illustrations of the opportunities offered by its College of Engineering. Highland Park College was founded in 1889 and opened to students in September of the following year. Since 1890 something over 30,000 students have been graduated. The institution embraces the Normal College, Academy, College of Liberal Arts, College of Law, College of Engineering, College of Pharmacy, College of Music, College of Oratory, College of Commerce, including commercial shorthand and typewriting and drawing and pen art, telegraphy and railway mail service departments, the Correspondence School and the Summer School. The physical laboratory, which is a new building adjacent to the electrical engineering laboratory, has experimenting rooms, one for elementary work and another for advanced work. The new electrical elaboratory has been fitted up recently with several thousand dollars' worth of electrical machines and smaller apparatus, and is now equipped with everything necessary to illustrate the elementary principles of electricity and magnetism, as well as all the principal tests on both direct and alternating-current machinery.

NEW PUBLICATIONS.

HOW TO BUILD UP FURNACE EFFICIENCY—This is the title of a practical little book on steam-boiler management and testing, published by J. W. Hays, Combustion Engineer, of 911 Ft. Dearborn Building, Chicago.

STEAM BOILER PRACTICE—The Department of the Interior of the U. S. Geological Survey in Bulletin No. 367 presents a study entitled "The Significance of Drafts in Steam Boiler Practice," by Walter T. Gray and Henry Kreisinger.

THE ILLUMINATOR—The *Illuminator* for April contains some interesting reflections concerning central stations and the advertising problem. There is also a graphic demonstration of the utilization of reflectors with tungsten lamps, and a short essay on folding tungstoliers.

AMERICAN EXPORT TRADE—The National Business League of America has compiled and published a volume devoted to practical suggestions for the development of American export trade, with directories of the chief cities of Brazil, Chili, Panama and Southeast Africa.

SERIES TUNGSTEN LIGHTING—A paper on this subject was read by Henry Schroeder at the seventeenth annual convention of the Northwestern Electrical Association, Milwaukee, Wis., January 20, 21, 1909, and has been reprinted with illustrations and diagrams, in pamphlet form, for distribution.

THE SIGNIFICANCE OF THE INSTITUTE—This was the address of Louis A. Ferguson, President of the American Institute of Electrical Engineers, at the twenty-fifth anniversary dinner held at the Hotel Astor, New York city, March 11 last. This address has now been published in leaflet form for distribution.

LIQUID TACHOMETERS—A paper by Amasa Trowbridge, Hartford, Conn., entitled, "Liquid Tachometers, Operation, Construction, and Method of Testing," and presented at the New York meeting (December, 1908) of the American Society of Mechanical Engineers, has been reprinted in pamphlet form. It contains a full description of the Veeder tachometer, manufactured by the Veeder Manufacturing Company, Hartford, Conn.

MAGNETIC OBSERVATIONS AT CHELTENHAM, MD.—The United States Coast and Geodetic Survey has published a report of 206 pages, giving the results of observations made at its magnetic observatory at Cheltenham, Md., during the years 1901-1904. Besides giving complete tabulated data some twenty pages are devoted to a description of the observatory and its equipment as well as the methods employed in making the observations.

PURCHASING COAL UNDER GOVERNMENT SPECIFICATIONS—Is a new bulletin just issued by the United States Geological Survey, Department of the Interior. It indicates the results obtained and deals with the government as a coal consumer, the general plan of purchase, specifications made, value of coal as a fuel, list of contracts, award of contracts and results. The treatise is by John Shober Burrows and is followed by a short paper on "The Burning of Small Sizes of Anthracite for Heat and Power Purposes," by Dwight T. Randall. The tabulated statistics in regard to contracts are decidedly instructive.

THE PURDUE ENGINEERING REVIEW—The Purdue Engineering Review, published by the engineering societies of Purdue University for 1909, has been issued. This is essentially a review of the more important work which is being carried out by graduates and students of the University. Among the articles of electrical interest are the following: "General Features of Overhead Construction for the Electrification of Main Trunk Lines," by Francis S. Denneen, class of 1903; "An Electrical Mine Hoist," by W. M. Hoen, '03; "Rehabilitation of the Street Railway Systems of Chicago," by Frederick E. Morrow, '04; "Problems of the Central-Station Electric Meter Department," by Earle A. Le Fever, '01; "Commercial Magnetic Testing," by J. Walter Esterline, '97; "Electric Cranes," by F. H. Miller, '04; "Neutralizing Transformers for Telephone Lines, Paralleling Single-Phase Railways," by J. H. Cannon, '07. The frontispiece is an excellent photograph of Charles Francis Harding, professor of electrical engineering at Purdue Universitiy, and there is also a group photograph of the Purdue Engineering Review staff.

PERSONAL MENTION.

HENRY D. SMITH, of Appleton, Wis., trolley line magnate, banker, paper mill owner and lawyer, died after an illness of several months. C.

C. A. VAN ORDSTRAND, of the city of Atlantic, Iowa, has been promoted to the position of state inspector of construction for the Bell Telephone Company, with headquarters at Des Moines, Iowa. C.

U. S. SLITER, until recently superintendent of transportation for the Mahoning & Shenango Railway and Light Company, has been appointed to take charge of one of the interurban divisions of the Detroit United Railway.

DAVID ATKINS, of the Treasury Department, division of public buildings, is in San Francisco, Cal., superintending the making of plans for a $40,000 auxiliary electric power plant to be installed at the United States mint.

F. W. KEISKER, president, JULIUS C. BECKMAN, vice-president, and A. T. MACDONALD, secretary, of the Southern Electrical and Industrial Exposition, which was held in Louisville, Ky., recently, were each presented with a handsome silver pitcher inscribed with an appropriate legend by the exhibitors. Quite a number of prominent electrical companies contributed to this tribute.

JAMES L. KIMBALL has been appointed by the Du Bois Iron Works, of Du Bois, Pa., to be the New England representative of that company, with offices at 53 State Street, Boston, Mass. The company has also appointed the James F. Marshall Company, 608 Chestnut Street, Philadelphia, Pa., general sales managers for eastern Pennsylvania, Delaware and the southern half of New Jersey.

CHARLES J. RUSSELL, one of the district managers of the Philadelphia Electric Company, will attend the Seventh International Congress of Applied Electricity, which will be held in London May 25 to June 2. After this Mr. Russell will visit various plants in England, France, Germany and Switzerland, investigating the various industrial applications of electricity with especial regard to electrochemical and electrometallurgical processes.

DR. GISBERT KAPP, at present occupant of the chair of electrical engineering at the Birmingham University, Birmingham, Eng., has been elected president of the British Institution of Electrical Engineers. Dr. Kapp, who may be described as an English-Austrian-German, is one of the most distinguished electrical engineers in the world by reason of his many inventions, his scientific papers, research and the extraordinary number of medals he has won. In 1894 he was secretary of the German Institute of Electrical Engineers. The appointment will be heartily approved by the electrical profession at large.

OBITUARY.

HENRY D. SMITH, ex-president of the Wisconsin Bankers' Association, secretary and treasurer of the Wisconsin Traction, Heat, Light and Power Company, president of the First National Bank and president of the Riverside Fibre and Paper Company, died at his home in Appleton, Wis., on April 26, at the age of sixty-seven years.

JAMES JONES passed away at his residence, 182 Madison Street, Brooklyn, Monday, April 26, at 1:15 a. m., after a short illness of pneumonia. He was born in Birmingham, England, September 20, 1832, of Welsh and English parents. As a boy, he became interested in electricity and a desire to broaden his knowledge brought him to New York. He got his start in the factory of Chester and Company, staying with them until the firm of Pearce & Jones, of which he was a member nearly twenty-five years, was started. Later with his son he formed the firm of J. Jones & Son. He was a worker to the day of his last illness and in his work was his life. His nature was quiet and unassuming. Truth stood out in everything he did, and he is sincerely mourned by all who knew him.

RALPH SCOTT, inventor of the Scott lamp and author of several books on electric engineering and automatic block signals, died on April 28, at his home, in Newark, N. J., while being operated upon for appendicitis. Although only twenty-six years old, he was the holder of forty patents and was considered an authority on street lighting. He was born in Bradford, England, and was brought to this country by his parents when a child. On graduation from the high school he was employed as an electrician, and when twenty-three years old was made Professor of Electrical Science at the New Century School, Wilkesbarre, Pa. Two years ago he went to Newark and founded the Scott Electrical Company and invented the Scott arc light. When stricken with his fatal illness Mr. Scott was engaged in making an arc light, that was to have been the largest in the world, for the Lackawanna railroad terminal at Hoboken. The globe measures six feet in diameter. Mr. Scott was also the inventor of an electric locomotive that showed a speed of 100 miles an hour.

ELECTRICAL SECURITIES.

An irregular and price-sagging tendency was the feature of the market last week, with little commission house business, indicating that general speculation is still holding off. Advances in steel prices indicate a bettering condition in this industry, and the report for the March quarter was favorably received. Railroad earnings also show improvement with a decided gain in tonnage being moved.

Dividends have been declared upon the following electrical securities: Mexican Telegraph Company has voted to issue 7,500 shares of new capital stock on June 1 as a twenty-five-per-cent stock dividend to shareholders of record on May 15. This stock will come in on the July dividend. The company will buy or sell fractions of shares on the basis of $2.50 a share. Electric Properties Company; usual quarterly of one-and-one-half per cent on preferred stock, payable May 10. Books closed May 1 and reopen May 11. Ohio Traction Company; the regular quarterly dividend of one-and-one-fourth per cent on its preferred stock, payable May 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MAY 1.

New York:	*Closing.*
Allis-Chalmers common	15⅝
Allis-Chalmers preferred	49¾
American Tel. and Tel. Company	140½
Brooklyn Rapid Transit	78¼
General Electric	159
Interborough-Metropolitan common	16⅞
Interborough-Metropolitan preferred	46½
Kings County Electric	122
Mackay Companies (Postal Telegraph and Cable) common	77½
Mackay Companies (Postal Telegraph and Cable) preferred	73
Manhattan Elevated	143⅜
Metropolitan Street Railway	27½
New York and New Jersey Telephone	123
Western Union	75¼
Westinghouse Manufacturing Company	82⅞

The regular annual meeting of the stockholders of the Interborough Rapid Transit Company will be held at the office of the company, 165 Broadway, borough of Manhattan, city of New York, on Wednesday, May 12, at 12 o'clock noon, for the election of five directors, to hold office for three years, and for the transaction of such other business as may be brought before the meeting.

Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	72
New England Telephone	132
Western Telephone and Telegraph pref.	85½

Philadelphia:	*Closing.*
Electric Company of America	12¼
Electric Storage Battery common	45
Electric Storage Battery preferred	45
Philadelphia Electric	11⅞
Philadelphia Rapid Transit	36
United Gas Improvement	88⅞

At the annual meeting of the Electric Company of America Clarence Moyer was elected a director to fill the vacancy caused by the death of George A. Colton.

Philadelphia Rapid Transit is expected to establish straight five-cent fares, which should add $1,800,000 to annual income. A conference will be held, at request of the city's representatives, to determine financial requirements of the company, before any action is taken by directors as to fares or transfers. If there is an advance in fares, an improvement in service will be demanded.

Chicago:	*Closing.*
Chicago Telephone	134
Commonwealth Edison	114
Metropolitan Elevated preferred	52¼
National Carbon common	82
National Carbon preferred	119¼

Vice-President Hibbard, of the Chicago Telephone Company, says that the total number of telephones in residences is 94,140 against 92,487 in business places, whereas New York has only 79,000 in residences out of 254,000 stations.

INDUSTRIAL ITEMS.

THE DIAMOND RUBBER COMPANY, Akron, Ohio, is making extensions to its plant which will give employment to 200 more men, thus making the total force about 4,000.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued Bulletin No. 1058, containing illustrated descriptions of typical interurban electric railways equipped by this concern.

THE VALENTINE-CLARK COMPANY, Chicago, Ill., is distributing a valuable souvenir reproducing in handsome style the Hon. Walter Malone's reply to John J. Ingall's "Opportunity."

THE GRONKVIST DRILL CHUCK COMPANY, 18 Morris Street, Jersey City, N. J., has published a new catalogue describing and illustrating the Johansson combination standard gauges.

THE AMERICAN ELECTRIC FURNACE COMPANY, 45 Wall Street, New York, N. Y., has published a new edition of its catalogue describing Kjellin, Colby and Rochling-Rodenhauser systems.

THE AMERICAN BATTERY COMPANY, 312-314 Fulton Street, Chicago, has occupied the entire building at those numbers since May 1, another welcome sign of steadily improving business conditions.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., had an interesting working exhibit of squirrel-cage induction motors for textile-mill service at the Textile Exhibit in Boston, Mass., April 26 to May 1 last.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has appointed Edmund Lang in charge of the repair shop. Mr. Lang for five years held an executive position with the Wheeler Condenser and Engineering Company.

MURALT AND COMPANY, New York city, have opened a branch office in the Temple Court Building, Bay and Richmond streets, Toronto, Ont. J. Engh, who has been prominently connected with the company for many years, will be in charge as manager.

THE BRISTOL COMPANY, Waterbury, Conn., has issued Bulletin 103, describing some recording instruments especially suitable for blast furnaces. These include recording pressure gauges, recording thermometers, electric time recorders, and indicating and recording electric pyrometers.

MAC GOVERN, ARCHER & CO., New York city, have issued their April list (No. 10) of second-hand electrical and steam machinery, such as is in first-class condition in every respect and ready for immediate shipment. This list, which cancels all previous issues, may be had on request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing several circulars describing the Badger portable electric lamps; also circulars on new types of lightning arresters for high and low tension direct and alternating current service; also, a sixteen-page circular on luminous and air radiators.

THE F. W. WAKEFIELD BRASS COMPANY, Vermillion, Ohio, has issued Catalogue No. 8, devoted to electrical and tungsten fixtures. This catalogue contains a number of new designs. The company also calls attention to its new patented detachable link chain, which has attracted considerable attention and is being popularly received by dealers all over the country.

THE BROWNING ENGINEERING COMPANY, Cleveland, Ohio, has issued the following bulletins: No. 31, showing the Browning lifting magnet and its applications; No. 34, describing automatic excavating buckets, wood grapples, etc. No. 35, describing and illustrating the Browning locomotive cranes.

THE WALLACE-BARNS COMPANY, Bristol, Conn., has distributed a mailing card illustrating some of its products. This company manufactures small springs of every description, screw-machine products, spring washers, ribbon steel, specialties in steel, brass and phosphor bronze, and also does tempering for the trade.

THE TUNGSTOLIER COMPANY, Cleveland, Ohio, made a very attractive exhibit of its system of illumination at the recent Southern Electrical and Industrial Exposition at Louisville, Ky. The Tungstolier system is a scientific assembling of artistic fixtures, tungsten lamps and Holophane reflectors, made up from engineering data and special recommendations, resulting in an equal distribution of light over a given area.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has instituted a campaign consisting of a series of newspaper advertisements for central stations who want more power business. This series includes a fine line of forceful, illustrated advertisements, bringing out the utility and feasibility of operating electric carriages and electric power wagons. The plates are so arranged that all that is necessary for use in any city is the setting up of the name of the central-station company.

THE HORNBERGER TRANSFORMER COMPANY, Lafayette, Ind., has published a very interesting booklet describing and illustrating the standard Hornberger transformer. This company has purchased all of the accounts receivable of the Lafayette Manufacturing Company, formerly manufacturing these transformers. The company has been equipping a new factory during the past two months, which will more than double the capacity of its old plant.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has recently issued the following literature: Bulletin 112, describing exhaust fans for use in the ventilation of factories, offices, stores, hotels, etc., or for drying lumber, hides, textiles, etc.; Bulletin 111, containing a most interesting description, in English and German, of the electric machinery in the brewery of Peter Doelger, New York city; Bulletin 113, describing direct-current motors and their applications for various industrial purposes.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued Booklet 3770 describing their telephone-line insulating transformer, which safeguards telephone users from high-voltage discharges as from contact with power lines, and provides insulation between the interior wiring, etc., and the line. Other recent publications are: Bulletin 4656, describing a portable current transformer for use in connection with the measurement of large currents; and Bulletin 4657, describing commercial-type searchlight projectors.

THE SIRCH ELECTRICAL AND TESTING LABORATORIES, Los Angeles, Cal., are the manufacturers of the Sirch rectifier, resonator and other special appliances. The company's line of rectifiers uses three methods of interrupting the cycles, the electrolytic, mercury vapor and static. The principal line consists of thirty sizes and types of electrolytic rectifiers. It is stated that without the use of any transformer the alternating current, after passing through this rectifier, is now being used directly on the board by a telephone company well known for its good service.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces that it has received a contract from the Falkenau Electrical Construction Company of Chicago, engineers for the Salt Lake & Ogden Railway Company, covering direct suspension line material for the thirty-seven miles of electrification of the present steam road between Salt Lake City and Ogden. In the same connection, a contract has been closed covering the line material for the Gallatin Valley Electric Railway Company, of Bozeman, Mont., for eighteen miles of new line; and an order has also been entered from the Long Island Railroad, covering twelve miles of low-voltage catenary construction.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has moved its Los Angeles office from the Citizens' National Bank Building, to larger and more convenient quarters at 129 East Fifth Street. The constantly increasing demand for the company's products on the Pacific Coast has compelled this change and necessitated an increase in the selling force, particularly in the steam and mining lines. J. F. Perry is district manager of the company at this office and E. H. Knepper, formerly with Ingersoll Rand Company, has now become identified with Allis-Chalmers Company's Los Angeles office in the capacity of salesman. The increased demand for all kinds of machinery and steam and electrical apparatus has also necessitated a larger selling force at the 599 Mission Street, San Francisco, office.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the second issue of each month.)

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, Lloyd Lyon, secretary and auditor Mobile Light and Railway Company, 158 Government Street, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y. Annual convention, Hot Springs, Va., May 24-27.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Street, New York city. Annual convention, Thousand Islands, N. Y., June 28.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th Street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill. Annual convention, Atlantic City, June.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 39 West Twenty-ninth Street, New York city.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, Flatiron Building, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY TRANSPORTATION AND TRAFFIC ASSOCIATION. Secretary B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark. Annual meeting, Hot Springs, Ark., May 12-14.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Chicago, Ill.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF EDISON PURCHASING AGENTS. Secretary, J. W. Brennan, Edison Illuminating Company, Detroit, Mich. Annual meeting, Atlantic City, N. J., June 1-4.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington Street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Chicago, Ill. Annual convention, Detroit, Mich., June 23-25.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada. Annual convention, Quebec, Canada, June 16-18.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda Street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Traction Terminal Building, Indianapolis, Ind.

CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, assistant claim agent Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CHICAGO. Secretary, Wm. S. Taussig, 204 Dearborn Street, Chicago, Ill.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRIC RAILWAY GENERAL MANAGERS' ASSOCIATION. Next meeting, Fort Wayne, Ind., May 26.

ELECTRICAL CLUB OF CALIFORNIA. Secretary, Russell D. Holabird, Argonaut Hotel, San Francisco, Cal.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, George William Russell, Jr., 500 Fifth Avenue, New York city.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine Street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, San Francisco, Cal. Monthly meetings, San Francisco, Cal., first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electric Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau Street, New York city.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt Street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINEERS' SOCIETY OF MILWAUKEE. Secretary, W. Fay Martin, Milwaukee, Wis.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Ottawa, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Preston S. Millar, Engineering Societies Building, 33 West Thirty-ninth Street, New York city.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Frederic Leslie, Muncie, Ind. Next meeting, August 18.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Allen J. Paylow, Rockport, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Annual convention, Atlantic City, N. J., September 14-16.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis, Parkersburg, W. Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, Des Moines, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill. Annual convention, Atlantic City, June.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MILWAUKEE SOCIETY OF ENGINEERS. Secretary, W. Fay Martin, 456 Broadway, Milwaukee, Wis.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-treasurer, B. W. Copperthwait, Faribault, Minn.

MISSISSIPPI ELECTRICAL ASSOCIATION. Secretary, J. Abbott, manager Jackson Electric Railway, Light and Power Company, Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATERWORKS ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schwerer, Windsor, Mo.

MUNICIPAL LIGHTING ASSOCIATION OF MASSACHUSETTS. Secretary, J. C. Norcross, Reading, Mass.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Annual convention, Toledo, Ohio, July 21-23.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill. Annual convention, Atlantic City, N. J., June 1-4.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Annual convention, Omaha, Neb., May 11-13.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary-treasurer, John E. Allen, manager Equitable Electric Light Company, Lake Geneva, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention, Toledo, Ohio, July 13-15.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Annual convention, Canton, Ohio, May 21-22.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, 195 Broadway, New York city. Annual reunion, Pittsburg, Pa., August 17-19.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Dr. Henry M. Stein, Harrisburg, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex. Annual convention, Dallas, Tex., May 20-22.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York city.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. A. Gould, Ennis, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WEST VIRGINIA INDEPENDENT TELEPHONE ASSOCIATION. Annual convention, Parkersburg, W. Va., May 27, 28.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Chairman, William B. Jackson, 115 Adams Street, Chicago, Ill.; secretary, J. H. Warder, Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

RECORD OF ELECTRICAL PATENTS.

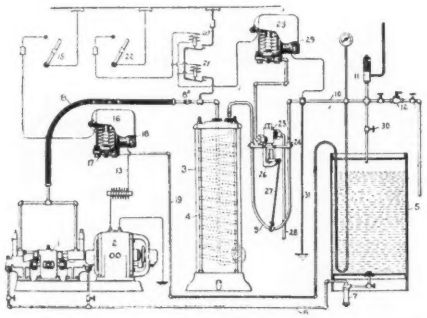
Issued (United States Patent Office) April 27, 1909.

919,302. MOTOR-CONTROL SYSTEM. Albert H. Armstrong, Schenectady, N. Y., assignor to General Electric Company. Filed July 21, 1906. The method of operating a railway induction motor as a braking generator driven by the car consists in interposing between the motor and the source a motor-generator, the field of which is excited by an alternating current, and then varying the frequency of the exciting current in accordance with variations in the speed of the braking generator.

919,323. TOOL FOR TWISTING WIRE-JOINTS. Clarence E. Cook, Chicago, Ill., assignor to Frank B. Cook, Chicago, Ill. Filed June 1, 1908. Consists of a trough-shaped handle bearing a wheel having grooves in its periphery to fit various sizes of wire and a clamping jaw to co-operate with the wheel.

919,338. TRANSFORMER. John J. Frank, Schenectady, N. Y., assignor to General Electric Company. Filed December 17, 1907. A core-type transformer having a core with four legs and a primary and a secondary winding each surrounding the two center legs is provided with connections from each winding between its end connections for adapting the transformer for operation on single-phase, two-phase, three-phase, or three-phase-two-phase circuits.

919,350. CLAMPING AND HEATING DEVICE. Albert B. Herrick, Cleveland, Ohio, assignor to the Electric Railway Improvement Company, Cleveland, Ohio. Filed November 25, 1904. A device for bonding rails comprises a support, a yielding stop attached thereto, a flexible conductor secured at one end to the support, and resting against the stop, means for adjusting the free end of the conductor and a high resistance mounted upon this free end.



919,364.—ELECTRIC HOT-WATER HEATING SYSTEM.

919,364. HEATING SYSTEM. Hermann Lemp and William G. Fisher, Lynn, Mass., assignors to General Electric Company. Filed November 17, 1906. An electric hot-water system contains a coiled pipe through which the water circulates and whose walls are electrically heated, a motor-driven circulating pump controlled by a pressure regulator, and a thermostat controlling the heating coil.

919,365. HEATING SYSTEM. Hermann Lemp, Lynn, Mass., assignor to General Electric Company. Filed July 1, 1908. A modification of the above in which the heating current passes through a meter that controls both the water and electric currents.

919,366. HEATING SYSTEM. Hermann Lemp, Lynn, Mass., assignor to General Electric Company. Filed July 2, 1908. A further modification of the above.

919,368. ELECTRIC ATTACHMENT FOR ALARM-CLOCKS. Abraham Lewis, New York, N. Y. Filed September 30, 1903. Renewed November 29, 1907. The turning of the alarm key closes the circuit of an electric bell.

919,377. ANNUNCIATOR. Elsworth Pickel, Portland, Ore. Filed November 18, 1907. A clock closes an adjustably set switch in an electric alarm circuit.

919,380. ILLUMINATED ROTARY SIGN. Edward Rappaport, Minneapolis, Minn., assignor of one-half to Carol Epcar, Minneapolis, Minn. Filed June 22, 1908. A rotary case journaled on a pin and spindle is provided with transparent sides and an electric lamp supported within it.

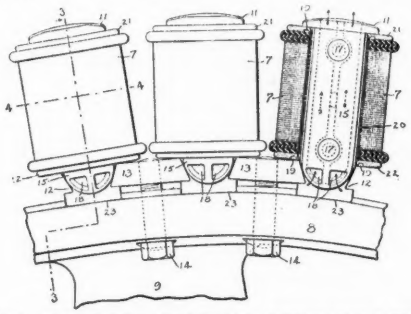
919,381. ELECTRIC GLOW-LAMP. Hermann Remané and Eugen Hurwitz, Berlin, and Emil Gottschalk, Charlottenburg, Germany, assignors to Deutsche Gasglühlicht Aktien Gesellschaft Auergesellschaft, Berlin, Germany. Filed July 18, 1907. Comprises a tungsten filament attached to the ends of supports containing an alloy of copper and nickel.

919,384. TELEPHONE-SWITCHBOARD CABLE. William L. Runzel, Chicago, Ill., assignor to Runzel-Lenz Electric Manufacturing Company, Chicago, Ill. Filed March 8, 1907. Is composed of a number of cable units with their axes in the same plane, an enclosing sheath therefor, and separate spacers between the cable units, the opposite walls of the sheath being sewed together by stitches passing through the spacers.

919,385. BURGLAR-ALARM FOR SUIT-CASES, SATCHELS, ETC. Arthur T. Ruthven, Topeka, Kan. Filed January 14, 1908. There are means whereby when the suit-case is lifted from its support an electric alarm will be sounded. Also contains a miniature electric lamp.

919,386. INSULATOR. Ferdinand Schaub, Jersey City, N. J. Filed January 11, 1908. Has two parts, one socket-shaped and the other shaped as a plug to fit the socket and to clamp a wire between the parts.

919,394. TELEPHONE JACK-BOX. John B. Taylor and Walter S. Bralley, Schenectady, N. Y., assignors to General Electric Company. Filed August 14, 1908. Contains line springs, a grounded spark-gap and contacts in circuit therewith adapted to be placed in circuit with the line springs when a jack is inserted.



919,511.—POLE RETAINER FOR REVOLVING FIELD.

919,399. PYROMETER. Charles B. Thwing, Philadelphia, Pa. Filed July 9, 1907. The casing has an opening at its outer end and a mica shield therefor, a thermo-electric couple at the inner end of the casing and a concentrating reflector between the outer end and the couple.

919,402. ELECTRICAL HEATING APPARATUS. Wilhelm E. Trümpler, Zurich, Switzerland. Filed February 25, 1907. An electric heating pad consists of a woven fabric formed of a textile woof and a warp of heating wires arranged in series-connected groups of wires individually in parallel and connected to an alternating current supply through an adjustable choke coil.

919,403. APPARATUS FOR THE PRODUCTION OF OZONE. Alexander Vosmaer, Philadelphia, Pa., assignor to the United Water Improvement Company, Philadelphia, Pa. Filed October 22, 1907. An ozonizer has a group of electrode units each consisting of a rod provided between its ends with an electrode, a tubular di-electric encircling the rod so as to permit the passage of air through it and a second tubular electrode encircling the di-electric, all arranged concentrically.

919,409. CLEAR-OUT SYSTEM FOR TELEPHONE SWITCHBOARDS. Klas Weman and Thomas S. Hemenway, Buffalo, N. Y. Filed May 29, 1908. A clear-out signal has a coil adapted to be connected across the cord circuit and controlled by a relay and switch.

919,411. ELECTRICAL APPARATUS FOR WORKING PLANING-MACHINES AND OTHER RECIPROCATING TOOLS. Alfred D. Williamson, Sheffield, England, assignor to Vickers Sons & Maxim, Limited, Sheffield, England. Filed December 11, 1908. An automatic controller for a reversible variable-speed motor permits the motor to change its revolution and speed for effecting in one direction the slow cutting stroke and in the other direction the quick return stroke.

919,423. LOCK-SWITCH FOR ELECTRIC METERS. William S. Cord, Oceanpark, and Herbert F. Heywood, Los Angeles, Cal. Filed September 16, 1908. The meter circuit is con-

trolled by a switch plug fitting a socket in the case in which it can be locked in either open or closed position.

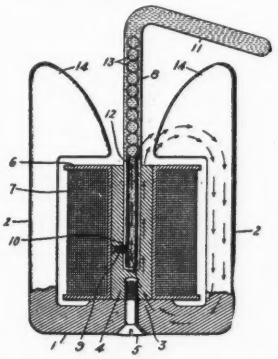
919,425. SPARK PLUG. Arthur A. Davis, Chicago, Ill., assignor of one-half to Benjamin Grieshaber, Chicago, Ill. Filed October 31, 1908. A pair of electrodes have their ends bent backward and provided with discharge points between the bends of their terminals arranged in opposition to each other.

919,432. ELECTRICAL TYPE-WRITER. Henry C. Horstmann, Chicago, Ill., assignor of one-fourth to Samuel Evans and one-fourth to John Howard McElroy, Chicago, Ill. Filed June 7, 1906. Each key controls a separate circuit including an electromagnet and an operating part moved thereby.

919,445. OZONIZER. Anthony Lohman, Philadelphia, Pa., assignor to W. W. Gibbs, Philadelphia, Pa. Filed January 20, 1909. An exterior casing constitutes one electrode, an interior discharger the other, and the di-electric consists of a shell arranged between the electrodes and detachable from each.

919,449. TROLLEY. Jeremiah T. Minahan, Philadelphia, Pa. Filed October 27, 1908. A bracket is secured near the top of the trolley-pole and a guard is pivoted to the bracket and disposed in advance of the trolley wheel, a spring being located between the guard and bracket.

919,450. THREE-POSITION SIGNAL. William V. Moak, Schenectady, N. Y., assignor to General Electric Company. Filed September 25, 1908. An electric motor moves the semaphore arm from danger to caution and to clear under the control of an electromagnet.



919,605.—MAXIMUM-DEMAND METER.

919,457. GALVANIC CELL. Heinrich P. R. L. Pörscke, Hamburg, Germany. Filed July 15, 1907. The depolarizing mixture contains graphite, manganese peroxide, chloride of iron, and ferrous hydrate. To the electrolyte is added a gum containing arabic and metarabic acids.

919,458. FIELD POLE FOR DYNAMO-ELECTRIC MACHINES. Heinrich Poth, Brooklyn, N. Y. Filed March 9, 1906. The pole piece is formed with an air space disposed near the leading horn and dividing the pole in two parts, transverse bridges of iron extending through the air space and connecting the parts together.

919,459. RECORDING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Filed April 7, 1903. A graphic recording instrument consists of a rotatable drum for carrying a record sheet, a driving mechanism for the drum, an electric meter nested in the drum and a marker moved over the sheet by the meter.

919,460. ELECTRICAL-CLUTCH MACHINE. William T. Price, Buffalo, N. Y. Filed November 20, 1907. An induction clutch is provided with a revolving field magnet mounted on a shaft and having a series of radial pole pieces electrically energized to form adjacent poles of opposite polarity, and a rotor with a copper-clad steel ring secured to the shaft, the ring surrounding the field magnet so as to carry magnetic flux from each pole to the adjacent poles.

919,463. ELECTRIC CONTROLLING MEANS. Charles S. Reno, Cincinnati, Ohio, assignor to the Triumph Electric Company. Filed December 12, 1907. A starting compensator for an induction motor consists of an auto-transformer and a double-throw switch having a starting, a running and an intermediate open position.

919,467. OSCILLOGRAPH. Lewis T. Robinson, Schenectady, N. Y., assignor to General Electric Company. Filed March 13, 1905. An instrument for recording wave shape consists of a light-tight box containing a number of reflecting galvanometers, means for directing a beam of light upon their mirrors, means for visibly noting movements of the mirrors and means for obtaining a photographic indication of these movements.

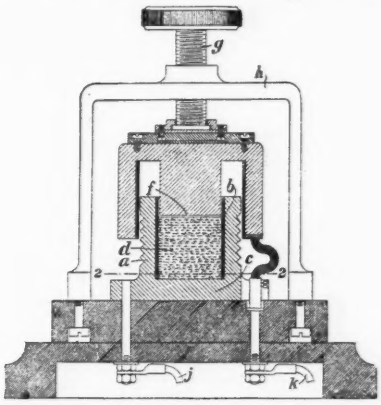
919,470. WIRE-COATING MACHINE. George H. Rupley, Schenectady, N. Y., assignor to General Electric Company. Filed March 25, 1907. Comprises an electrically heated oven with coating rolls at the upper end and means for passing the wire through the rolls to the bottom of the oven and back through the top.

919,472. ELECTRICAL SWITCH. Frank W. Sanford, Chicago, Ill., assignor of one-half to Herbert C. Wirt, Burrage, Mass. Filed July 24, 1908. A push-button flush wall-switch.

919,473. COMBINED SWITCH AND CUT-OUT. Howard R. Sargent, Schenectady, N. Y., assignor to General Electric Company. Filed December 1, 1902. A rotary snap switch is provided with enclosed fuses.

919,474. INCANDESCENT LAMP. Howard R. Sargent, Schenectady, N. Y., assignor to General Electric Company. Filed August 1, 1904. A cluster socket has an insulating base provided with a number of side recesses and divided into sections by a surface passing through the axes of the recesses.

919,489. ELECTRIC HEATER. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed November 29, 1907. A box has an apertured top consisting of an elongated heating unit and spaced strips pivoted for movement in a vertical plane about the axis of the unit.



919,908.—ELECTRIC RESISTANCE.

919,491. AUTOMATIC TRUNKING APPARATUS FOR ELECTRICAL CIRCUITS. Lawrence O. Surles, Atlanta, Ga. Filed June 30, 1906. A common-battery telephone-signaling system.

919,493. REFINING STEEL. Otto Thallner, Bismarckhütte, Germany, assignor to The Firm of Bismarckhütte, Germany. Filed June 17, 1908. Consists in previously refining the steel in a basic-lined electric furnace and then treating the partially refined steel in a crucible for the purpose of settling, and adding carbonizing agents.

919,495. INDICATOR AND ADVERTISER. Charles H. Townsend, Berkeley, Cal. Filed December 23, 1907. A theatrical program-indicating band and an advertising band are connected by an electromagnetically controlled worm to an electric motor.

919,506. MEANS FOR REDUCING THE FREEZING POINT OF OIL. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Company. Filed October 1, 1904. A high flashing-point mineral insulating oil has its freezing point reduced by adding benzyl chloride.

919,510. EDGEWISE-WINDING MACHINE. James J. Wood, Fort Wayne, Ind. Filed October 2, 1907. Consists of two concentric shafts, a face-plate on one of them having parallel ways extending across it, a carriage slidable in the ways, a crank disc mounted on the other shaft and operating connections between the disc and the carriage.

919,511. DYNAMO-ELECTRIC MACHINE. James J. Wood, Fort Wayne, Ind. Filed November 22, 1907. A revolving field has laminated pole pieces, each lamina having similar indentations on both sides of it, a steel retaining piece fitting in the indentations and bolts clamping the retainers to the spider, thus holding the poles in place.

919,514. ELECTRIC MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed January 12, 1907. A motor of the commutator type has all the field coils connected to assist in producing the main field magnetization for operation on direct current and em-

ploys a portion of the field coils for producing a commutating field for alternating-current operation.

919,516. PANEL BOARD FOR ELECTRIC POWER DISTRIBUTION. Millard E. Ames, Chicago, Ill., assignor of one-half to Frederick R. Jenkins, Chicago, Ill. Filed October 21, 1908. A panel board for a three-wire system is provided with meters for the branch circuits and that can be connected to any of the latter by means of plugs passing through superposed bars.

919,519. TELEPHONE CUT-OUT AND LIGHTNING ARRESTER. William E. Ashby, Chariton, Iowa. Filed February 18, 1908. Comprises a series of combs mounted on an insulating base with a double-pole knife switch.

919,523. ELECTRIC MOTOR. Ralph E. Barker, Lynn, Mass., assignor to General Electric Company. Filed October 14, 1907. The armature is loosely mounted on the shaft, a clutch connecting them together. A centrifugal device carried by the armature controls the motor switch and the clutch.

919,524. INDUCTION MOTOR. Harold L. Barnholdt, Pittsfield, Mass., assignor to General Electric Company. Filed October 31, 1907. Has on its rotor a single squirrel-cage winding with end rings open circuited at a number of points, and centrifugally-actuated contacts arranged to bridge the breaks in the end rings when the motor is up to speed.

919,527. INDUCTION MOTOR. Swen R. Bergman, Lynn, Mass., assignor to General Electric Company. Filed October 21, 1905. A high resistance squirrel-cage winding is carried in open slots at the periphery of the rotor core and a lower resistance squirrel-cage winding is carried in closed slots in the body of the core.

919,535. AUTOMATICALLY-OPERATED ELECTRIC SWITCH. Joseph C. Calhoun, Holland, Mich., assignor of one-half to George P. Hummer, Holland, Mich. Filed September 17, 1906. A rock shaft carries the contact members.

919,537. INDUCTION-MOTOR CONTROL. Frank E. Case, Schenectady, N. Y., assignor to General Electric Company. Filed July 8, 1908. A controller for a slip-ring induction motor is arranged to cut out rotor resistances step by step and at the same time to cut primary resistance out and in alternately.

919,547. DYNAMO-ELECTRIC MACHINE. William F. Dawson, Rugby, England, assignor to General Electric Company. Filed July 15, 1908. Combined with a set of collector rings and the brushes therefor is a device for short-circuiting the rings, means for moving the device into and out of action, and means for moving the brushes into and out of the brush holders.

919,548. BELT-TIGHTENING DEVICE. Jules E. Delhomme, Paris, France, assignor to General Electric Company. Filed February 13, 1907. Describes the construction of the guide rails for a motor pedestal.

919,563. SUBMERGED FUSE. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. Filed May 4, 1905. A fuse is submerged in an oil tank and there are means for causing the gases produced by its blowing to force the liquid to stream past the fused ends.

919,569. LIGHTNING ARRESTER. William Gifford, Traverse City, Mich. Filed March 25, 1908. Mounted on a base are spaced insulating plates, each having its inner face coated with a high resistance compound to form a number of conducting paths, an insulating spacing strip being interposed between the plates and terminating below their upper ends to form a recess in which is seated a distributing bar connected with the conducting paths.

919,571. CLAMPING-EAR FOR TROLLEY WIRES. Frank Guillot, Schenectady, N. Y., assignor to General Electric Company. Filed October 10, 1907. A tubular holder has an open mouth along its under side, two jaws with enlarged upper portions adapted to slide lengthwise into the holder and means for forcing the upper edges of the jaws apart.

919,573. CONTROL OF RAILWAY APPARATUS. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. Filed July 16, 1908. Includes a reversible compound motor, a magnetic clutch and a small differentially wound excitor.

919,575. RHEOSTAT. Harry E. Heath, Lynn, Mass., assignor to General Electric Company. Filed August 4, 1905. A rheostat consists of a cast silicon unit, and a controlling arm mounted for contact therewith.

919,577. RAIL-BOND. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed December 19, 1907. Has a laminated body and sheet metal cap enclosing an end thereof. There is a perforated base and a rib integral therewith and extending between two of the laminations.

919,578. RELAY. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed September 28, 1908. A weight is supported out of engagement with the armature but is movable into engagement therewith if the relay is tipped over.

919,584. VAPOR ELECTRIC DEVICE. Paul A. Huguenin, Paris, France, assignor to General Electric Company. Filed November 21, 1907. A mercury-vapor lamp is provided with a solenoid for tilting the tube at start and a cut-out for the solenoid operated by the tilting movement.

919,588. SPEED-CONTROLLING DEVICE. Joseph W. Jones, New York, N. Y. Filed October 24, 1907. A gas-engine controller includes a main circuit governing the sparking circuit and a valve electrically actuated by means of a switch adapted to close the circuit through any one of a number of shunts.

919,593. DENTAL ENGINE. Michael Kelly, Hammond, Ind., assignor to Frank S. Betz, Hammond, Ind. Filed April 25, 1908. A motor-driven dentist's machine has a flexible shaft connected to the rotor by a universal joint.

919,597. MAGNETIC DRILL-FRAME. Walter Klous and Chester H. Brockett, Columbus, Ohio. Filed March 18, 1907. A portable drill has electromagnets in its supporting legs for holding it to the surface to be drilled.

919,604. DYNAMO-ELECTRIC MACHINE. Hans Lippelt, Lynn, Mass., assignor to General Electric Company. Filed February 3, 1908. The machine has an open-coil armature, a field having main poles unevenly spaced with respect to the armature and provided with both shunt and series windings and auxiliary commutating poles occupying the spaces left by this uneven spacing, and provided with series winding.

919,605. ELECTRIC DEMAND INSTRUMENT. William J. Lloyd, Pittsfield, Mass., assignor to General Electric Company. Filed January 16, 1905. A maximum-demand meter consists of an iron-clad solenoid with a fixed core and a movable core which moves outwardly as the current increases.

919,623. ELECTRICALLY-DRIVEN FAN OR BLOWER. Edgar J. McDuffee, Lynn, Mass., assignor to General Electric Company. Filed March 17, 1905. Combined with a motor and blower driven thereby are means for causing more or less as desired of the air displaced by the blower to be drawn through the motor.

919,626. COLLECTOR RING. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed November 26, 1907. The collector rings of a unipolar generator have elastic supporting portions, those of adjacent rings being in contact with each other so that the rings may expand or be compressed and may return to their former shape.

919,633. DISTRIBUTION SYSTEM. Frank W. Peek, Jr., Schenectady, N. Y., assignor to General Electric Company. Means for maintaining a definite division of load between two self-excited generators connected in parallel comprise a voltage regulator for each machine responsive to its voltage and the load on the other machine.

919,640. SPEED-RECORDER AND CURVE-DRAWING INSTRUMENT. Lewis T. Robinson and Charles C. Badeau, Schenectady, N. Y., assignors to General Electric Company. Filed July 29, 1901. Combined with an integrating meter is a curve-drawing mechanism for recording its speed of rotation.

919,644. PROCESS OF INSULATING ELECTRIC CONDUCTORS. George H. Rupley, Schenectady, N. Y., assignor to General Electric Company. Filed October 14, 1907. Consists in revolving the conductor and applying asbestos fiber thereto by means of an adhesive and then picking the excess fiber from the conductor.

919,646. TRANSMITTER FOR IMPULSE-DRIVEN CLOCK SYSTEMS. Frederick M. Schmidt, Brooklyn, N. Y., assignor to Self Winding Clock Company, Brooklyn, N. Y. Filed November 5, 1908. For electrically controlling secondary clocks from a master clock there is a transmitter comprising a clock movement independent of the master clock and having a number of electric contact devices adapted to be momentarily and simultaneously closed by it.

919,647. FEED AND POSITIVE LOCK FOR CLOCK-TRAINS. Frederick M. Schmidt, Brooklyn, N. Y., assignor to Self Winding Clock Company, Brooklyn, N. Y. Filed November 5, 1908. A step-by-step feeding device for clock trains has a feeding pawl acting on a toothed wheel and an electromagnet for actuating the pawl.

919,662. REGISTER FOR TELEPHONES. William O. Weissich, San Francisco, Cal. Filed December 29, 1906. A local register consists of a plunger operated by the subscriber and

closing an indicating circuit at the switchboard and a lock normally preventing any movement of the plunger except when released by an electromagnet controlled by the operator.

919,670. SYSTEM OF ELECTRICAL DISTRIBUTION. Joseph L. Woodbridge, Philadelphia, Pa. Filed August 3, 1906. Between an alternating current and a direct-current source is a rotary converter arranged to transfer energy from one to the other and to shift the phase relation of its alternating potential with changes in the alternating-current source.

919,672. SOLENOID. Carl J. Anderson, Chicago, Ill., assignor to J. L. Schureman Company, Chicago, Ill. Filed October 16, 1908. Associated with an alternating-current solenoid is a core movable in the coil and adapted to contact a bar of magnetic material movable in the opening.

919,691. ELECTRICALLY-ILLUMINATED DRINKING GLASS. Joseph H. Cahill, St. James, N. Y. Filed November 23, 1908. A goblet contains an incandescent lamp in its stem, which is illuminated by resting it upon a sub-base containing an electric battery.

919,696. INDIVIDUAL PROTECTOR. Frank B. Cook, Chicago, Ill. Filed June 10, 1908. A fusible conductor has an iron core and a copper sheath surrounding the core.

919,710. STERILIZER. Alphonse J. Gero, Waterville, Me. Filed May 28, 1908. Contains an electric heating element adapted to be inserted into the casing.

919,724. ELECTROLYTIC METER. George Hookham and Sydney H. Holden, Birmingham, England. Filed June 1, 1908. Has a storage of gas and an anode capable of absorbing the gas, the anode and cathode being partly immersed in electrolyte and partly in the gas.

919,744. ELECTRIC-FUSE CASE. Thomas E. Murray, New York, N. Y. Filed September 28, 1908. An Edison plug fuse is enclosed in pulverized material in a case covered by a hard-rubber disc.

919,763. TROLLEY-WIRE SUPPORT. John W. Porter, Chicago, Ill., assignor to Electric Service Supplies Company, Camden, N. J. Filed November 16, 1907. A pair of clamping members is arranged to interlock upon relative longitudinal movement in one direction.

919,771. POLE. William Roberts and Carroll Roberts, Springfield, Ohio. Filed January 13, 1908. A pole for carrying electric wires has collars near the top and base, between which are several guy wires anchored into the concrete base.

919,772. POLE. William Roberts and Carroll Roberts, Springfield, Ohio. Filed February 4, 1908. A reinforced concrete pole for carrying electric wires.

919,790. SECONDARY ELECTRIC CLOCK. Jacob Steiger and James Besancon, La Chaux-de-Fonds, Switzerland. Filed July 7, 1908. Combined with a hand-operating wheel is a pallet co-acting therewith and an electric motor unlimited in its rotary movement and connected so as to actuate the pallet.

919,811. ELECTRICAL SWITCH. Harry A. Beynon, Chicago, Ill. Filed May 11, 1907. The switch is arranged for manual closing and for instantaneous automatic opening.

919,812. TELEPHONE APPARATUS. Clarence E. Bilton, Bridgeport, Conn. Filed July 28, 1908. A case for the transmitter is made of sheet metal having the center of its front stamped out to receive the diaphragm and mouthpiece.

919,821. INCANDESCENT ELECTRIC LIGHT. Walter J. Carpenter and Thomas F. McDermott, Providence, R. I. Filed August 16, 1907. Has a high and a low-powered filament controlled by a pull-string socket.

919,830. TERMINAL FOR ELECTRIC CABLES. Charles W. Davis, Edgeworth, Pa. Filed June 5, 1907. Consists of a thimble and plug having a centrally-conducting coil surrounded by a body of insulating material formed externally with a downwardly and outwardly flaring leakage-preventing petticoat.

919,843. ELECTRIC HEATER. Walter C. Fish, Lynn, Mass., assignor to General Electric Company. Filed January 13, 1906. A cooking device comprises an annular base having a smooth tapering inner surface and supported in an elevated position, electrical means for heating the same and a receptacle adapted to fit closely to the base.

919,851. MACHINE FOR MAKING INCANDESCENT-LAMP MOUNTS. John E. Graybill, York, Pa., assignor to General Electric Company. Filed October 8, 1903. Combined with a rotatable support are a number of mount-forming devices, a driving wheel secured to each, a power wheel adapted to rotate this support, and means for shifting the wheel from the support and to engage it successively to the driving wheels of the mount-forming devices.

919,862. SQUIRREL-CAGE ROTOR FOR ELECTRIC MOTORS. Edward Heitmann, Montclair, N. J., assignor to Crocker-Wheeler Company, Ampere, N. J. Filed July 15, 1908. The ends of the conducting bars are slotted transversely on the side toward the shaft and in the slots are placed end rings joining corresponding bars.

919,877. INSULATED RAIL JOINT. Joshua C. Jones, Wilkes-Barre, Pa. Filed March 27, 1908. Is provided with an inner and an outer splice bar, each having a facing of insulating material.

919,898. ELECTRIC-FAN SUPPORT. Evrah C. Lipps, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio. Filed January 8, 1908. Consists of a fixed yoke, a motor having a neck, a base plate having a central opening to receive the neck and screws mounted in the yoke supporting the base plate.

919,900. PRIMARY ELECTRIC BATTERY. George A. Lutz, Plainfield, N. J. Filed December 12, 1908. Suspended from the cover is a rod carrying positive plates and a depolarizing plate insulated from each other.

919,904. COIN-CONTROLLED APPARATUS. Frank Magidson, Pittsburg, Pa., assignor to Westmoreland Automatic Machine Company, Irwin, Pa. Filed April 13, 1908. A motor-driven machine is controlled by an auxiliary circuit that can be closed by a coin.

919,908. ELECTRICAL RESISTANCE DEVICE. Harold S. Martin, Liverpool, England. Filed July 13, 1908. Consists of a mixture of mica in the form of scales, a granular material and finely-divided graphite enclosed in a cylinder in which a variable pressure can be exerted.

919,940. OUTLET FIXTURE FOR CONDUITS. Henry T. Paiste, Philadelphia, Pa. Filed March 18, 1908. Consists of a hollow structure having a lamp socket mounted over one of its openings and a conduit secured to the unthreaded portion of another opening by a set screw.

919,953. GOVERNING MECHANISM FOR AIR COMPRESSORS. Richard H. Rice, Lynn, Mass., assignor to General Electric Company. Filed August 17, 1908. A motor-driven compressor has means responsive to changes in the volume of air entering the compressor for regulating the speed of the motor.

919,968. TROLLEY-WHEEL BEARING. Albert C. Sloan, Salamanca, N. Y. Filed August 28, 1908. A tubular axle has a lubricating reservoir section with an enlarged head provided with an outlet communicating with the bearing surface of the wheel.

919,982. APPARATUS FOR CONTROL OF RAILWAY TRAINS. Per Utne, New York, N. Y., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed August 3, 1908. Electromagnetic means under the control of a track trip are provided for opening the air-brake valve.

919,986. ELECTRIC DRIVE FOR MACHINES. Eddy R. Whitney, Lynn, Mass., assignor to General Electric Company. Filed November 8, 1904. The motor is suspended below the lathe bed and drives the lathe spindle through a vertical shaft geared to the spindle shaft.

919,994. ELECTRIC SWITCH. Gilbert Wright, Pittsfield, Mass., assignor to General Electric Company. Filed August 3, 1905. A double-throw switch has means for locking it in its open position and a means for freeing the switch for movement to only one of its closed positions.

919,996. ELECTRIC SIGNALING SYSTEM. Samuel M. Young, New York, N. Y., and John J. Townsend, administrator of Fitzhugh Townsend, deceased, assignors to said Young. Original application filed November 21, 1903. Divided and this application filed September 2, 1908. The track rails of an electric railway are divided into block sections by means of impedances. Each block is supplied from a transformer with alternating current for signaling.

919,998. STARTING RHEOSTAT. Paul H. Zimmer, Schenectady,, N. Y., assignor to General Electric Company. Filed December 26, 1907. In series with a resistance-varying arm are two independently-actuated switches and means whereby one is closed mechanically and the other electromagnetically upon an initial movement of the arm.

920,005. PLUG FUSE. Harry U. Badeau and Frederick P. Poole, Bridgeport, Conn., assignors to the Bryant Electric Company, Bridgeport, Conn. Filed December 19, 1908. A ventless fuse plug has a cup-shaped insulating body with terminals and contains within it only a flat fuse-strip having at one place a reduced cross-section for the melting point.

920,024. ELECTRIC CLOCK. Edward E. Clement, Washington, D. C. Filed December 2, 1905. Electrical indicating devices are arranged in groups with a lead for each group and a set

of returns, one for each set of corresponding devices in all the groups.

920,030. SWITCH SIGNAL. Roy B. Cunningham, Chicago, Ill. Filed October 8, 1908. A signal rod connected to the switch point so as to be latterly shifted by it is adapted to close a signal circuit.

920,032. ELECTRIC SWITCH. Charles W. Denny, Middletown, Ohio, assignor to the Barkelew Electric Manufacturing Company. Filed August 3, 1908. A multipolar double-throw switch carries an enclosed fuse in series with one of its blades in one position.

920,034. TELEGRAPHIC TRANSMITTER. Paul Dinger, Cleveland, Ohio, assignor of one-half to W. Louis Rose, Cleveland, Ohio. Filed July 25, 1907. Combined with the main vibrator is a fixed weight, a speed and contact-adjusting device, and a bell-crank lever connected with the key under spring tension so as to impart accelerated force toward the vibrator for producing sharp, distinct dots.

920,036. RELAY. Frank L. Dodgson, Buffalo, N. Y. Original application filed May 17, 1906. Divided and this application filed November 3, 1906. Renewed June 6, 1908. Comprises an electromagnet with its armature, a pole-changing arm and permanent magnets surrounding the three sides of the pole pieces and arranged as to their polarity so that the magnetic effect of all four poles tends to rotate them in the same direction.

920,040. SINGLE-PHASE MOTOR. Friedrich Eichberg, Berlin, Germany, assignor to General Electric Company. Filed May 22, 1908. Is provided with an inducing winding on the stator, a rotor winding with a commutator, connections for short-circuiting the rotor on the line of magnetization of the inducing winding, connections arranged to produce a rotor magnetization at an angle to the line and means for supplying at the brushes a shunt voltage assisting that induced by the inducing winding.

920,043. TELEPHONE PARTY-LINE SWITCHING APPARATUS. Arthur J. Farmer, Detroit, Mich. Original application filed December 26, 1903. Divided and this application filed April 19, 1905. Combined with an electromagnetically-rotatable element are stationary springs for effecting the control of the party-line circuits and a pair alternative to all of the other springs and normally opening or controlling the electromagnet.

920,045. TIME-LIMIT CIRCUIT-BREAKER. Wilhelm Fellenberg, Charlottenburg, Germany, assignor to General Electric Company. Filed August 29, 1907. A thermostatic strip of large section actuates the tripping mechanism of the breaker and a similar strip of small section controls the tripping action of the first strip.

920,052. TURBO GENERATOR. Brace H. Hamilton and William E. Ver Planck, Lynn, Mass., assignors to General Electric Company. Filed April 19, 1907. A cooling device for the enclosed generator includes a fan, baffle plates to prevent the entrance of foreign matter and a nozzle for directing the air to the center of the machine.

920,073. APPLICATION AND DISTRIBUTION OF ELECTRIC MOTIVE POWER, PARTICULARLY FOR USE IN STARTING MACHINERY AND FOR SIMILAR PURPOSES. George W. Mascord, London, England. Original application filed January 9, 1905. Divided and this application filed April 9, 1906. An electric motor is provided with a slow-speed positive clutch and a high-speed friction clutch, a hand lever operating the clutches successively and electrical means for locking the high-speed one in operative position.

920,078. ELECTRICAL FURNACE. Hans Nathusius, Friedenshütte, near Morgenroth, Germany. Original application filed May 6, 1908. Divided and this application filed August 25, 1908. The electrodes are arranged to be guided by slots in the roof of the furnace and additional electrodes are arranged to cause current to pass through and around the material in the hearth.

920,084. RECORDING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Company. Original application filed April 7, 1903. Divided and this application filed August 10, 1907. Combined with a movable coil is a stretched wire passed through the bearings on the coil to position it, and a bifilar suspension for sustaining the weight of the coil.

920,088 and 920,089. RECORDING AND PRINTING METER. Howard A. Selah, North Wildwood, N. J., assignor of one-half to James McLinden, North Wildwood, N. J. Filed May 5 and August 3, 1908. A circuit-closing disc is operatively geared to the armature shaft and has a tooth adapted to close the circuit to the magnet of the counting mechanism. A plunger when manually operated is adapted to press a strip of paper into engagement with the counting mechanism. In the second patent a lever is provided which momentarily closes the circuit to the recording mechanism when the armature stops.

920,097. NEUTRALIZING INDUCTIVE DISTURBANCES. John B. Taylor, Schenectady, N. Y., assignor to General Electric Company. Original application filed July 28, 1906. Divided and this application filed November 20, 1907. The disturbance due to a single-phase railway is diminished in neighboring conductors by placing the primary of a transformer in series with the trolley wire and connecting its secondary with a resistance shunt to the line formerly disturbed.

920,103. BATTERY-CHARGING APPARATUS. Frank E. Case, Schenectady, N. Y., assignor to General Electric Company. Filed November 25, 1908. A switch for connecting the battery to a source of charging current has operating means for closing it automatically and periodically opening it temporarily.

REISSUES.

12,946. PREPARATION OF THE INDIGO-VAT EMPLOYED IN DYEING. Henri Chaumat, Paris, France. Filed October 8, 1908. Original No. 885,978, dated April 28, 1908. Consists in treating by electrolysis a solution of alkaline sulphides with exclusion of air, the cathode containing a mixture including indigo.

12,947. STARTER FOR ELECTRIC MOTORS. William C. O'Brien, Baltimore, Md., assignor to Monitor Manufacturing Company of Baltimore City, Baltimore, Md. Filed March 24, 1909. Original application filed June 24, 1907. Renewed February 14, 1908. Original No. 891,722, dated June 23, 1908. An automatic starter consists of two solenoids operating a series of resistance-eliminating switches.

12,950. ELECTROMAGNETIC TRACTION DEVICE AND EMERGENCY BRAKE. Charles A. Wells, Chicago, Ill., assignor to Magnetic Equipment Company. Filed September 27, 1906. Original No. 771,193, dated September 27, 1904. Combined with a magnetizable wheel is an electromagnet and a non-rotating magnetizable shoe in circuit with the wheel and adapted to move in contact with the rail to form a brake.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired May 4, 1909:

473,911. TELEPHONE-EXCHANGE APPARATUS. J. J. Carty, New York, N. Y.

473,929. SOLENOID AND ITS ELECTRICAL CONNECTIONS. H. H. Hosford, Cleveland, Ohio.

473,932. SYSTEM OF ELECTRICAL CONDUCTORS. C. J. Kintner, New York, N. Y.

473,955 and 473,956. ELECTRIC ARC LAMP. C. A. Pfluger, Chicago, Ill.

473,966. TELEPHONE SWITCH. C. E. Scribner, Chicago, Ill.

473,975. ELECTRICAL ANNUNCIATOR. F. W. Steeg, St. Paul, Minn.

474,003. ELECTRIC LAMP HANGER. E. Dills, Sprague, Wash.

474,037. TROLLEY WIRE CIRCUIT-BREAKER. J. M. Anderson, Boston, Mass.

474,049. INSULATING SUPPORT FOR ELECTRIC-RAILWAY WIRES. A. A. Shobe and William Embley, Jerseyville, Ill.

474,050. ELECTRIC SWITCH. J. J. Wood, Fort Wayne, Ind.

474,067. HOUSE-TELEPHONE SYSTEM. C. E. Scribner, Chicago, Ill.

474,073. ELECTRIC RESISTANCE BOX. A. Wirsching, New York, N. Y.

474,091. ELECTRIC ARC LAMP. W. B. Luce, Brookline, Mass.

474,165. REGULATOR FOR DYNAMOS AND MOTORS. W. H. Elkins, Boston, Mass.

474,166. SYSTEM OF ELECTRICAL DISTRIBUTION. W. H. Elkins, Cambridge, Mass.

474,214. TELEPHONE RECEIVER. A. T. Collier, Caterham Valley, England.

474,230, 474,231 and 474,232. SPEAKING TELEGRAPH. T. A. Edison, Menlo Park, N. J.

474,266. ELECTRIC ARC LAMP. A. L. Shepard, London, England.

474,323. TELEPHONE CIRCUIT. H. V. Hayes, Cambridge, Mass.